This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

S B
824
M6 A2
1899
Entomol.

UC-NRLF
B 3 965 663

FIFTH ANNUAL REPORT

OF THE

ENTOMOLOGIST

OF THE

State Experiment Station

OF THE

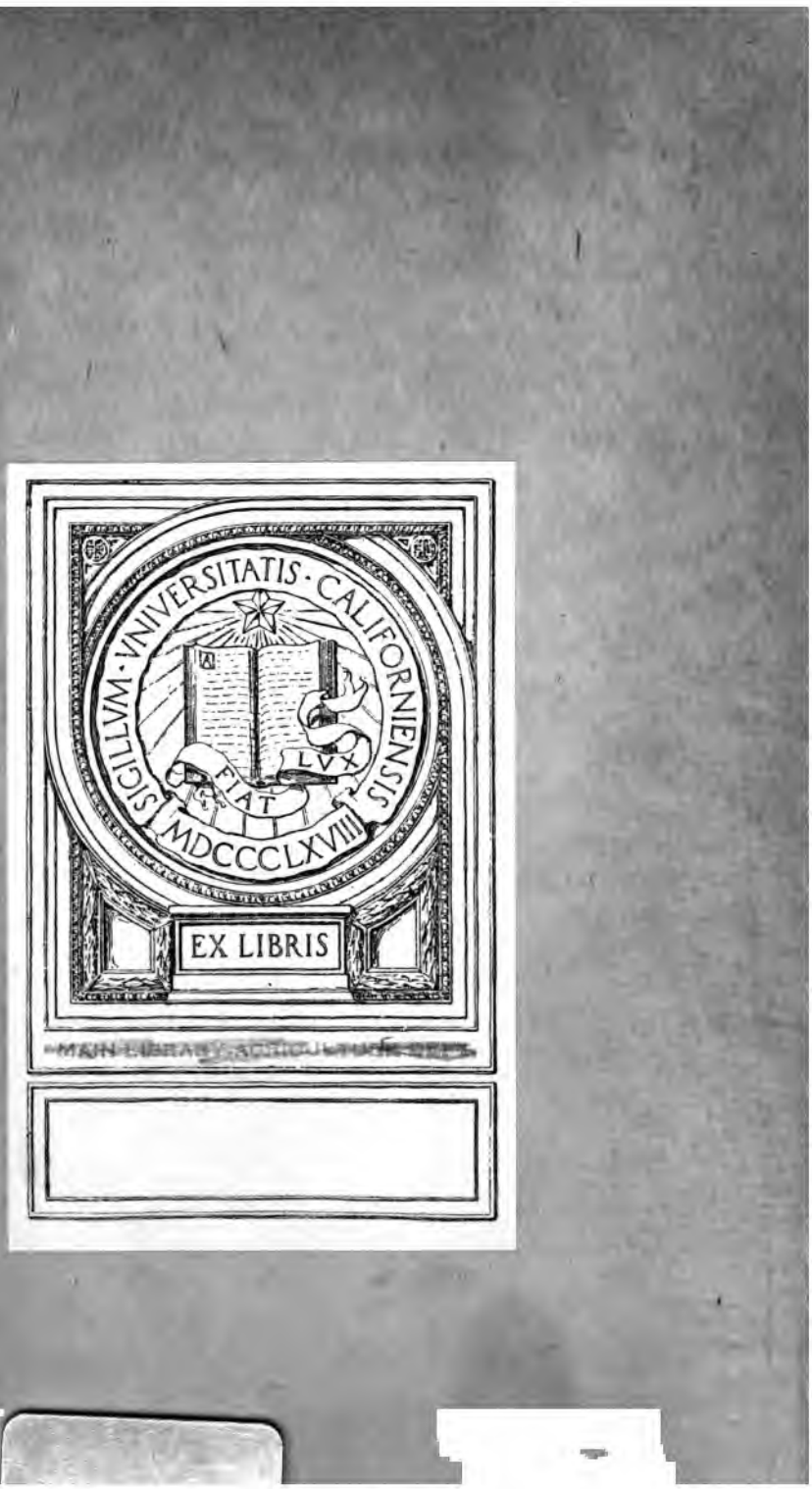
University of Minnesota,

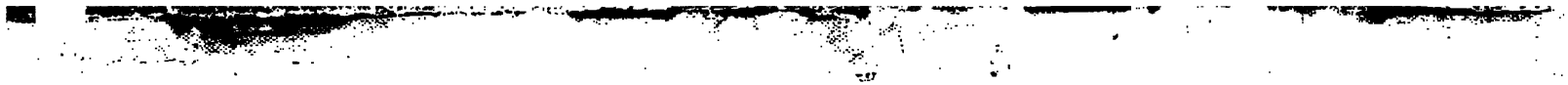
TO THE GOVERNOR,

FOR THE YEAR 1899.

BY OTTO LUGGER,
PROFESSOR OF ENTOMOLOGY,
UNIVERSITY OF MINNESOTA.

ST. PAUL.
McGILL-WARNER COMPANY.
1899.


SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
LVX
FIAT
MDCCCLXVIII
EX LIBRIS



FIFTH ANNUAL REPORT

OF THE

ENTOMOLOGIST

OF THE

State Experiment Station

OF THE

University of Minnesota,

TO THE GOVERNOR,

FOR THE YEAR 1899.

BY OTTO LUGGER,
PROFESSOR OF ENTOMOLOGY,
UNIVERSITY OF MINNESOTA.

ST. PAUL:
McGILL-WARNER COMPANY.
1899.

FIFTH ANNUAL REPORT

OF THE

ENTOMOLOGIST

OF THE

State Experiment Station

OF THE

University of Minnesota,

TO THE GOVERNOR,

FOR THE YEAR 1899.

BY OTTO LUGGER,
PROFESSOR OF ENTOMOLOGY,
UNIVERSITY OF MINNESOTA.

ST. PAUL:
McGILL-WARNER COMPANY.
1899.

LETTER OF TRANSMITTAL.

STATE EXPERIMENT STATION,
UNIVERSITY OF MINNESOTA.
December 31, 1899.

To His Excellency, John Lind, Governor of Minnesota:

SIR—In accordance with the law, I have the honor to present herewith my fifth annual report as Entomologist of the Experiment Station of the University of Minnesota for the year ending December 31, 1899.

Very respectfully,

Your obedient servant,

OTTO LUGGER.

MAIN LIBRARY-AGRICULTURE DEPT.

FINANCIAL REPORT.

1898.			No. of Vouchers.	Amount.
Sept.	1	To salary and labor for August, 1898	1-4	$145.00
	1	" postage	5	15.00
	1	" bill of Art Engraving Co	6	17.50
	1	" " " J. H. Herbst	7	2.05
	1	" " " Noyes Bros. & Cutler	8	.90
	1	" " " Zimmerman Bros	9	9.50
	1	" " " F. Beer	10	4.15
	1	" trips to Mankato and Owatonna	11-12	10.54
	1	" express, ice and expenses	13-14	7.55
Oct.	1	" salary and labor for September, 1898	1-3	115.00
	1	" bill of Art Engraving Co	4	20.00
	1	" " " C. T. Leonard	5	.60
	1	" " " J. H. Fough	6	3.30
	1	" " " N. Y. Entomological Soc	7	4.00
	1	" " " Art Engraving Co	8	22.35
	1	" trips to Pipestone, Duluth, Randolph, Rochester	9-10	17.49
	1	" express	11	.60
	1	" bill of Zimmerman Bros	12	19.33
	1	" St. Anthony Park Ice Co	13	2.00
	1	" trip to Fergus Falls	14	6.50
	1	" meat and expenses	15	5.20
Nov.	1	" salary and labor for October, 1898	1-4	120.00
	1	" bill of Art Engraving Co	5	22.35
	1	" " " Brooks Bros	6	2.67
	1	" " " stamps	7	5 00
	1	" trip to Pipestone	8	3.50
	1	" bill of Zimmerman Bros	9	3.00
	1	" freight	10	2.25
	1	" bill of G. Fock	11	10.90
Dec.	1	" salary and labor for November, 1898	12-14	90.00
	1	" bill of G. E. Stechert	15	24.23
	1	" " " Art Engraving Co	16	32.40
	1	" " " Zimmerman Bros	17	3.12
	1	" " " Whitall, Tatum & Co	18	35.15
	1	" expenses		3.15
1899.				
Jan.	1	" salary for December, 1898	1-3	90.00
	1	" bill of Art Engraving Co. (ill. for Report).	4	67.00

561232

1899.			No. of Vouchers.	Amount.
Jan.	1	To bill of A. L. Quaintance	5	1.50
	1	" " " American Stamp Works	6	2.40
	1	" " " Gruenhagen Bros	7	5.41
	1	" " " Hansen Bros	8	10.25
	1	" " " Ballard City Expr	9	8.20
	1	" " " J. B. Colt & Co	10	26.45
	1	" " " freight	11	1.50
	1	" " " John A. Schlener & Co	12	11.70
	1	" " " Art Engraving Co	13	61.00
	1	" " " Ben. S. Benton	14	1.70
	1	" " " expenses		6.10
	1	" printing 4th Annual Report McGill-Warner Co.)		1,456.00
Feb.	1	" salary and labor for January, 1899	1-4	105.00
	1	" bill of Bausch and Lomb Optical Co	5	63.39
	1	" " " N. Y Entomological Soc	6	4.00
	1	" " " St. Anthony Park Ice Co	7	5.50
	1	" " " Gruenhagen Bros	8	2.68
	1	" " " Art Engraving Co.	9	44.00
	1	" " " Gesner & Washburn	10	5.22
	1	" " " Zimmerman Bros	11	7.35
	1	" " " J. B. Colt & Co	12	50.00
	1	" express and expenses	13	5.60
	1	" bill of G. E. Stechert	14	13.50
Mch.	1	" salary and labor for February, 1899	1-4	72.50
	1	" stamps	5	15.00
	1	" express	6	6.20
	1	" trip to Champaign, Ill	7	60.05
	1	" " " Randolph	8	1.80
	1	" bill of McGill-Warner Co	9	100.00
	1	" expenses		1.95
April	1	" salary and labor for March, 1899	1-4	85.00
	1	" stamps	5	15.00
	1	" trips to Lake City and Randolph	6-7	5.46
	1	" bill of Zimmerman Bros	8	5.60
	1	" " " Gruenhagen Bros	9	7.00
	1	" " " H. F. Wickham	10	12.00
	1	" " " Allen Bros.	11	2.50
	1	" express, meat and expenses	12-13	6.47
	1	" S. E. Olson Co	14	.50
	30	" salary and labor for April, 1899	1-3	85.00
	30	" bill of Noyes Bros. & Cutler	4	43.39
	10	" " " A. Boss	5	11.02
	30	" express	6	3.70
	30	" bill of Zimmerman Bros	7	6.86
	30	" " " Bausch & Lomb Optical Co	8	13.70

1899.			No. of Vouchers.	Amount.
	30	To bill of Canadian Entomologist	9	3.00
	30	" trip to Eureka and expenses	10	4.60
May	31	" salary and labor for May, 1899	1-3	85.00
	31	" bill of Richards & Co	4	24.99
	31	" " " Gruenhagen Bros	5	1.15
	31	" " " White Manuf. Co	6	4.00
	31	" " " Am. Ent So	7	4.00
	31	" " " Bausch & Lomb Optical Co	8	1.00
	31	" " " Mpls. Paper Co	9	5.95
	31	" " " M. J. O'Neil	10	3.00
	31	" " " Bausch & Lomb Optical Co	11	6.25
	31	" " " Zimmerman Bros	12	18.70
	31	" " " St. Anthony Park Ice Co	13	3.00
	31	" " " Kennedy Bros	14	.20
	31	" " " Herbst Bros	15	1.57
	31	" " " J A. Standen.	16	5.90
	31	" " " express and freight	17-18	6.30
	31	" trips to White Bear and expenses.	19-20	5.00
	31	" bill of G. E. Stechert.	21	16.36
June	30	" to salary and labor for June, 1899	1-5	330.00
	30	" to trip to Randolph	6	5.40
	30	" stamps.	7	15.00
	30	" trip to Friesland	8	3.25
	30	" expenses and express	9-10	5.90
	30	" bill of G. E. Stechert	11	16.94
	30	" " " W. M. Simms	12	1.18
	30	" " " W. F. Lindig	13	3.00
	30	" " " W. Boss	14	2.00
	30	" " " C. Faber	15	8.90
	30	" trip to Fergus Falls..	16	14 16
	30	" expenses in Fergus Falls..	17	3.50
	30	" trip to Winnepeg	18	10.50
	30	" bill of Zimmerman Bros	19	14.90
	30	" expenses		2.50
July	31	" salary and labor for July, 1899	1-5	330.00
	31	" stamps...	6	15.00
	31	" bill of G. E. Stechert.	7	41.83
	31	" expenses and express	8, 15	5.80
	31	" bill of Kennedy Bros	9	4.00
	31	" " " Noyes Bros. & Cutler	10	1.30
	31	" " " Zimmerman Bros	11	4.36
	31	" " " Gruenhagen Bros	12	5.70
	31	" " " W. F. Lindig	13	2.00
	31	" trip to Miller and expenses	14	6.06
				$4,455.58

TABLE OF CONTENTS.

	Page.
Letter of Transmittal	ii
Financial Report	iii
Table of Contents	vii
Introduction	xiii
Beetles Injurious to our Fruit-producing Plants	1
Structure, Metamorphosis, etc	1
Classification	12
I. Coleoptera (Typical or True Beetles)	12
1. Isomera (Similar Joints)	12
A. Carnivorous Beetles (Adephaga)	14
Family *Cicindelidæ* or Tiger-beetles	14
Family *Carabidæ* or Ground-beetles	17
Family *Dytiscidæ* or Predaceous Water-beetles	24
Family *Gyrinidæ* or Whirligig-beetles	26
B. Club-horns (*Clavicornia*)	27
Family *Hydrophilidæ* or Water-scavenger-beetles	28
Family *Silphidæ* or Carrion-beetles	29
Family *Scydmænidæ* and *Pselaphidæ*	30
Family *Staphylinidæ* or Rove-beetles	32
Family *Coccinellidæ* or Lady-bugs	33
Family *Endomychidæ* and *Erotylidæ*	37
Family *Cucujidæ*	37
Family *Dermestidæ* or Larder-beetles, Carpet-beetles, etc	39
The Raspberry Fruit-worm (*Byturus unicolor* Say)	41
Family *Histeridæ*	41
Family *Nitidulidæ* or Sap-beetles	42
Family *Trogositidæ* or Cadelles	43
C. Saw-horns (*Serricornia*)	44
Family *Elateridæ* or Snapping, Clicking or Spring-beetles	45
Family *Buprestidæ* or Flat-headed Borers	50
The Divaricated Buprestis (*Dicerca divaricata* Say)	52
The Flat-headed Apple-borer (*Chrysobothris femorata* Fab.)	53
The Red-necked Blackberry-borer (*Agrilus ruficollis* Fab.)	58
Family *Lampyridæ* or Fire-flies and Soldier-beetles	62
Family *Cleridæ* or Checkered-beetles	64
Family *Malachiidæ*	66
Family *Ptinidæ* or Death-watch; Cigarette-beetles	67
The Apple-twig Borer (*Amphicerus bicaudatus* Say)	69

Page.

The Red-shouldered Sinoxylon (*Sinoxylon basilare* Say)..... 70
D. Leaf-horns (*Lamellicornia*)..... 72
Family *Lucanidæ* or Stag and Pinching-beetles..... 72
The Stag-beetle (*Lucanus dama* Thunb.)..... 73
Family *Scarabæidæ* or Lamellicorn-beetles..... 75
The Rose-chafer or Rose-bug (*Macrodactylus subspinosus* Fab.)..... 80
The Silken Serica (*Serica sericea* Ill.)..... 82
The May-beetles or June-bugs (*Lachnosterna spec.*)..... 83
The Light-loving Anomala (*Anomala lucicola* Fab.)..... 90
The Spotted Vine-chafer (*Pelidnota punctata* Linn.)..... 93
The Goldsmith-beetle (*Cotalpa lanigera* Linn.)..... 94
The Southern June-beetle or Fig-eater (*Allorhina nitida* Linn.)..... 99
The Indian Cetonia (*Euphoria inda* Linn.)..... 101
The Melancholy Cetonia (*Euphoria melancholica* Gory)..... 103
The Hermit Flower-beetle (*Osmoderma eremicola* Knoch)..... 104
E. Plant-eaters (*Phytophaga*)..... 106
Family *Cerambycidæ* or Long-horns..... 107
The Broad-necked Prionus (*Prionus laticollis* Drury)... 109
The Grape-vine Phymatodes (*Phymatodes amœnus* Say)..... 111
The Belted Hickory-borer (*Chion cinctus* Drury)..... 112
The Oak Pruner (*Elaphidion paralellum* Newm.)..... 113
The Apple-tree Pruner (*Elaphidion villosum* Fab.)..... 115
The Two-spotted Hickory-borer *Tylonotus bimaculatus* Hald.)..... 117
The Two-spotted Molorchus (*Molorchus bimaculatus* Say)..... 117
The Painted Hickory-borer (*Cyllene pictus* Drury)..... 118
The American Currant-borer (*Psenocerus supernotatus* Say)..... 121
The Beautiful Hickory-borer (*Goes pulchra* Hald.)..... 123
The Long-horned Borer (*Leptostylus aculifer* Say)..... 124
The Apple Lepturges (*Lepturges facetus* Say)..... 125
The Twig-girdler (*Oncideres cingulatus* Say)..... 126
The Round-headed Apple-tree Borer (*Saperda candida* Fab.)..... 126
The Raspberry Cane-borer (*Oberea bimaculata* Oliv.).. 131
Family *Chrysomelidæ* or Leaf-beetles..... 133
The Asparagus-beetle (*Crioceris asparagi* Linn.)..... 135
The Dominican Case-bearer (*Coscinoptera dominicana* Fab.)..... 136

Page.
The Grape-vine Fidia (*Fidia longipes* Mels.) 138
The Grape-root Worm (*Fidia viticida* Walsh) 139
The Strawberry Root-worms (*Paria canella* Fab. and others) 141
The Cloaked Chrysomela *Glyptoscelis crypticus* Say) ... 145
The Plum Leaf-beetle (*Nodonota tristis* Oliv.) 145
The Cherry Leaf-beetle (*Adimonia femoralis* Melsh.) 152
The Grape-vine Flea-beetle (*Haltica chalybea* Ill.) 157
The Lesser Grape-vine Flea-beetle (*Haltica ignita* Ill.) .. 159
The Apple-tree Flea-beetle (*Haltica foliacea* Lec.) 160
The Red-headed Systena (*Systena frontalis* Fab.) 165
The Rosy Hispa (*Odontota nervosa* Panz.) 167
The Tortoise-beetles 168
Family *Bruchidæ* or Pea-weevil Beetles 170
2. *Heteromera* (Different Joints) 171
Family *Tenebrionidæ* or Darkling-beetles 172
Family *Mordellidæ* 175
Family *Meloidæ* or Blister-beetles 176
II. *Rhynchophora* (Snout-beetles; Bark-beetles) 178
Family *Rhynchitidæ* 179
Family *Attelabidæ* or Leaf-rolling Snout-beetles 180
Family *Otiorhynchidæ* or Scarred Snout-beetles 182
The Imbricated Snout-beetle (*Epicærus imbricatus* Say) 182
The Gray Anametis (*Anametis grisea* Horn) 183
The Pitchy-legged Otiorhynchus (*Otiorhynchus ovatus* Linn.) 184
The Fuller's Rose-beetle (*Aramiges Fulleri* Horn) 186
Family *Curculionidæ* or Genuine Snout-beetles 186
The New York Weevil (*Ithycerus noveboracensis* Forster) 187
The Plum-gouger (*Coccotorus scutellaris* Lec.) 193
The Apple Curculio (*Anthonomus quadrigibbus* Say) ... 196
The Cranberry Curculio (*Anthonomus suturalis* Lec.) .. 199
The Strawberry Curculio (*Anthonomus signatus* Say). 199
The Plum Curculio (*Conotrachelus nenuphar* Hbst.) 201
The Walnut Curculio (*Conotrachelus juglandis* Lec.) ... 207
The Quince Curculio (*Conotrachelus cratægi* Walsh) 207
The Strawberry Crown-borer (*Tyloderma fragariæ* Ril.) 209
The Grape Curculio (*Craponius inæquaiis* Say) 210
The Grape-vine Gall-beetle (*Ampeloglypter Sesostris* Lec.) 212
The Chestnut Weevil (*Balaninus caryatrypes* Boh.) 215
Family *Brenthidæ* or Brenthids 216
Family *Calandridæ* or Bill-bugs; Grain-weevils 217

Page.
Family *Scolytidæ* or Bark-beetles; Engraver-beetles..... 220
The Apple Bark-beetles (*Monarthrum mali* Fitch)..... 222
The Pear-blight Beetle (*Xyleborus pyri* Peck)..... 226
The Fruit Bark-beetle (*Scolytus rugulosus* Ratz.)..... 229
The Hickory Bark-beetle (*Scolytus 4-spinosus* Say)..... 231
Family *Anthribidæ* or Fungus-beetles..... 234

COLEOPTERA

OR

BEETLES.

INTRODUCTION.

The fifth annual report of the Entomologist of the State Experiment Station of the University of Minnesota, respectfully submitted to His Excellency, Governor John Lind, contains an account of all beetles found in Minnesota which in their larval and adult stages are destructive to our fruit-bearing trees, shrubs and canes, and which frequently cause considerable losses to our fruit-growers.

As orchards are now established in many parts of the state, and as the insects destructive to the plants are not as well known to our horticulturists as they are to those in the older settled regions of the United States, where horticulture as a business has been carried on for many years, a report describing and illustrating these insects, and giving the best remedies to prevent their injurious influence, is much needed. It was, however, impossible to describe all the numerous and destructive insects found in our orchards in one single report, and for this reason only the very important order of beetles is described in the following pages. Since the equally important order of butterflies and moths has been treated in a similar manner in the fourth annual report, the present one may be called a continuation of the same, and it is the intention to describe the rest of the insects injurious to the same plants in the next report.

It would, perhaps, have been best to have the insects described in this report arranged according to their food-habits, but to make it also useful to students of our public schools, etc., the insects are arranged according to the classification of Coleoptera usually adopted, and the different families have been described in a few words.

There remains for the Entomologist the pleasant duty of

expressing his sincere thanks to all persons that have aided him in many ways in his work. Especial thanks are due to His Excellency, Governor John Lind, who always took great interest in the work of the Entomologist, and also to the different newspapers, who with unfailing courtesy published all articles written for the instruction of the farmers in regions infested by injurious insects. The Chicago, St. Paul, Minneapolis and Omaha, the St. Paul and Duluth, the Northern Pacific, the Minneapolis and St. Louis, the Great Northern, and the Minneapolis, St. Paul & Sault Ste. Marie Railroad Companies also deserve thanks for their liberality in furnishing free transportation over their roads whenever such was asked.

The descriptions of many of the insects given are taken from a number of sources, but mainly from the excellent works of Saunders, Smith, Comstock, Forbes, and of the Annual Reports of the Division of Entomology. Most of the illustrations are old, and many were kindly loaned by Dr. L. O. Howard, Chief of the Entomological Division of the Department of Agriculture. The Art Engraving Co., of St. Paul, prepared some of the illustrations for the printer, and deserves credit for its good work.

OTTO LUGGER.

UNIV. OF CALIFORNIA

BEETLES

(*Coleoptera*)

INJURIOUS TO OUR FRUIT-PRODUCING PLANTS.

This extensive Order of insects embraces over 80,000 different kinds of beetles, of which over 11,000 species are found in North America north of Mexico. A very large number of destructive beings is placed in this order. They are not alone injurious to the foliage and fruit, but also to the very trunks and roots of trees. Some of them exist freely exposed in all their stages, while many more live hidden in infested plants, in fruit, in seeds, and in the soil near by. Notwithstanding the various forms at home in all conceivable places, they are readily recognized as beetles, and only a very few rare species may give the farmer trouble in placing them in the Order to which they belong. In a few words the following definition will describe all kinds of beetles: *they possess a pair of horny wing-covers called elytra, which meet on the back in a straight line, i. e., do not overlap, and beneath these horny organs are the true wings, composed of more or less delicate membranes. The mouth-parts are formed for biting, not for sucking. The metamorphosis is complete, or, in other words, the different stages do not resemble each other, and the pupa is inactive, neither moving about nor taking food.*

Any insect possessing the above characteristics is a beetle, and in Minnesota there need be no difficulty in recognizing it as such. The scientific term *Coleoptera* is derived from two Greek words: *coleos,* a *sheath,* and *pteron,* a *wing.* This name characterizes these insects very well, as the horny and sheath-like elytra or wing-covers protect the delicate true wings below. Sometimes these elytra cover the whole upper part of the abdomen as well. Although they occupy the position of the fore-wings, they are, perhaps, not true wings at all, as in all events they are not used for flight. The hind-wings are membranous and excellent organs for flight, being mostly very large, with few but strong supporting veins. When not in use these wings are snugly folded be-

neath the horny wing-covers. To enable the beetle to fold such large organs beneath the very much smaller elytra they are not only folded lengthwise like a fan, but also crosswise, which is made possible by a sort of hinge or joint beyond their middle. The structure of both elytra and true wings can be best studied by

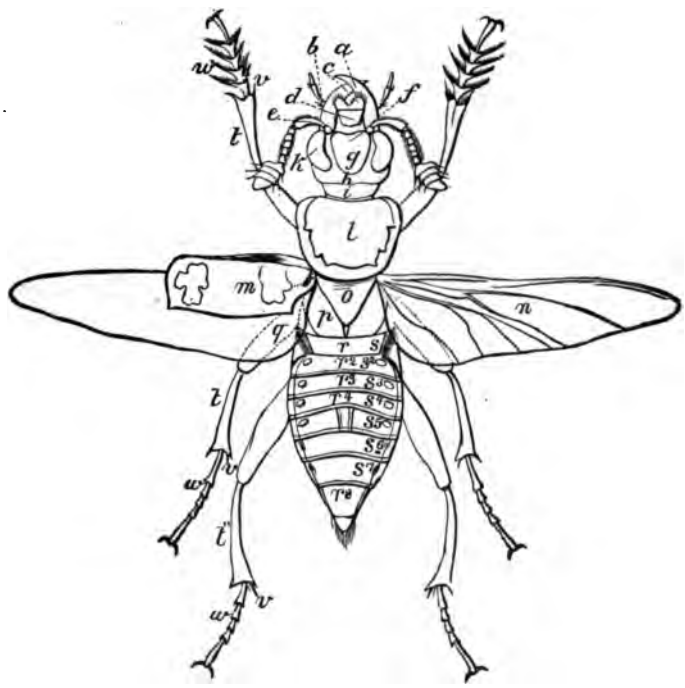


Fig. 1.—Upper surface of *Necrophorus americanus:* *a*, mandible; *b*, maxillary palpus; *c*, labrum; *d*, clypeus; *e*, antennæ; *f*, front; *g*, vertex; *h*, occiput; *i*, neck; *k*, eye; *l*, pronotum (usually called prothorax); *m*, elytron; *n*, hind wing; *o*, scutellum of meso-thorax; *p*, metanotum (or dorsal surface of meta thorax); *q*, femur or thigh; *r*, *r*, *r*, tergites of the abdomen; *s*, s^2, s^3, spiracles or stigmata; *t*, *t'*, *t''*, tibiæ, *v*, tibial spurs; *w*, tarsi. After Leconte.

dissecting some common large beetle. Fig. 1 shows both an elytron (m), and a true wing (n); Fig. 3 shows the same organs in a Tiger-beetle (*Cicindela*).

There are a number of beetles that do not fly, and, according to the natural law that organs not used become in time rudimentary, the lower or true wings have dwindled to almost

nothing, or have disappeared entirely. In many cases of this kind we find that the wing-covers do not simply meet on the back, but that they are actually soldered together, so that the elytra form one solid piece; the suture can, however, readily be detected. (Compare illustrations 180 and 181).

The exposed parts of the body of most beetles are very hard and horny. This is at least the case with all such as lead an active life, and is very necessary to their very existence, not only as a protection, but also because the muscles enabling them to run or fly have to be fastened to this exterior skeleton. Less active

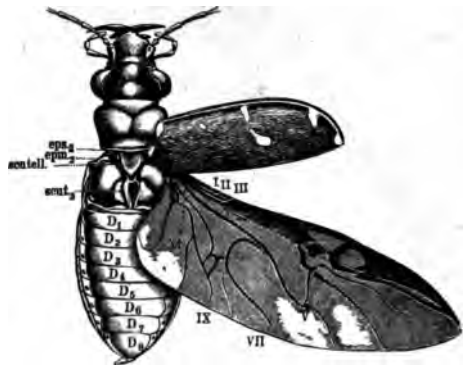


Fig. 3.—Upper surface of *Cicindela: epis*^{2}, episternum of meso-thorax; *epm* epimeron of meso-thorax; *scutell.*, scutellum; *scut*^{3}, scutum of meta-thorax; *D*—*D*^{8}, dorsal segments of abdomen; *I*, vena marginalis; *II*, vena mediastina; *III*, vena scapularis; *V*, vena externo-media; *VII*, vena cubitalis, *IX*, vena interno-media; *XI*, vena analis. After Ganglbauer.

beetles, and all others in their earlier stages, in case they are not forced to search for their food or when surrounded by some protecting material, as soil, wood, or fruits, are usually softer; their outer covering, which is composed of chitine, a horn-like substance, is in such cases soft, frequently very much so. Such a pliable skin is very important in the early stage of a beetle, as it enables the larva to stretch during its rapid growth, and to form the organs of the adult insect while changing to a pupa.

The biting mouth-parts are well developed in all *true beetles*, and we do not find some of them enlarged at the expense of others, as in the case of butterflies and moths. The upper lip or

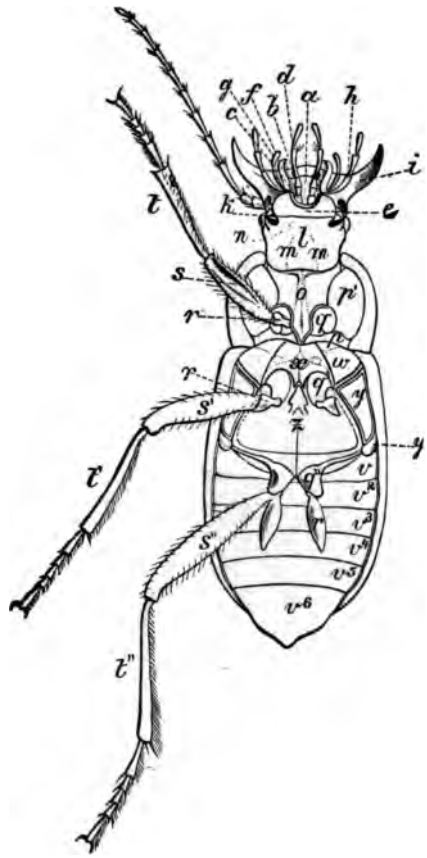


Fig. 2.—Under surface of *Harpalus caliginosus:* *a*, ligula; *b*, paraglossa, *c*, supports of labial palpi; *d*, labial palpus; *e*, mentum; *f*, inner lobe of maxilla; *g*, outer lobe of maxilla; *h*, maxillary palpus; *i*, mandible; *k*, buccal opening; *l*, gula or throat; *m*, *m*, buccal sutures; *n*, gular suture; *o*, pro-sternum; *p'*, episternum of pro-thorax; *p*, epimeron of pro-thorax; *q*, *q'*, *q''*, coxæ; *r*, *r'*, *r''*, trochanters; *s*, *s'*, *s''*, femora or thighs; *t*, *t'*, *t''*, tibiæ; *v*, v^2, v^3, etc., ventral abdominal segments; *w*, episterna of meso-thorax (the epimeron is just behind it); *x*, meso-sternum; *y*, episternum of meta-thorax; *y'*, epimeron of meta-thorax; *z*, meta-sternum. After Leconte.

labrum is usually distinct; the *mandibles* are strong jaws which can be used for gnawing and for seizing the prey; the complicated *maxillae* are also well developed and are composed of several pieces; the *maxillary palpi* are usually prominent; the lower lip or *labium* is composed of several pieces, and bears prominent *labial palpi*. All these parts are shown in Figs. 2, 4, 5 and 7.

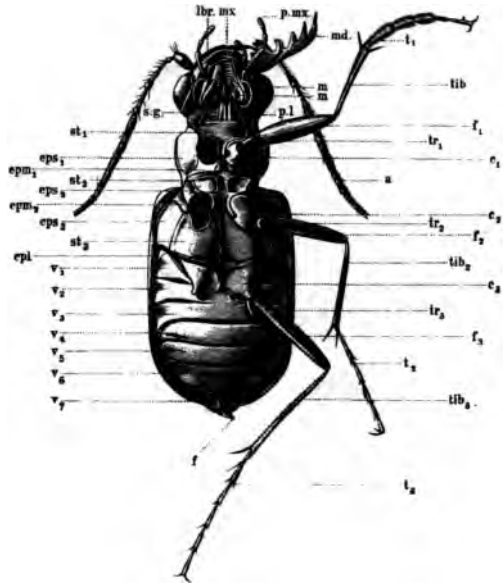


Fig. 4.— Under surface of male *Cicindela*: *a*, antenna or feeler; *lbr*, anterior margin of labrum; *md*, mandibula; *mx*, maxilla; *p. mx*, maxillary palpus; *m*, mentum; *p. l.*, labial palpus; *s. g.*, gular suture; *st*, prosternum; st^2, mesosternum; st^3, metasternum; eps^1, eps^2. eps^3, episterna of pro-, meso- and meta-thorax; epm^1, epm_2, epimera of pro- and meso-thorax; v-v^7. ventral segments of forceps; c^1, c^2, c^3, coxæ; tr^1, tr^2, tr^3, trochanters; f^1, f^2, f^3, femora; tib^1, tib^2, tib^3, tibiæ; t^1, t^2, t^3, tarsi. After Ganglbauer.

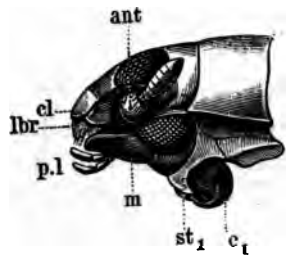


Fig. 7.—Head and thorax of *Gyrinus* from the side: *ant*, antennæ or feeler; *cl*, clypeus; *lbr*, labrum; *p. l.*, labial palpi; *m*. mandible; *st*, prosternum; *c*, coxa of front leg: each compound eye is divided into two parts, one above the antennæ and one below. After Ganglbauer.

The *Snout-beetles*, which form the suborder *Rhynchophora* of the order *Coleoptera*, have the head more or less prolonged into a snout or beak called the *rostrum*, which is in some cases longer

than the rest of the body. Such beaks, as may be seen in the figures illustrating snout-beetles, vary greatly, being sometimes broad and short, long and thin, or straight or curved. At the very tip of this beak we find the sharp jaws, at least when the

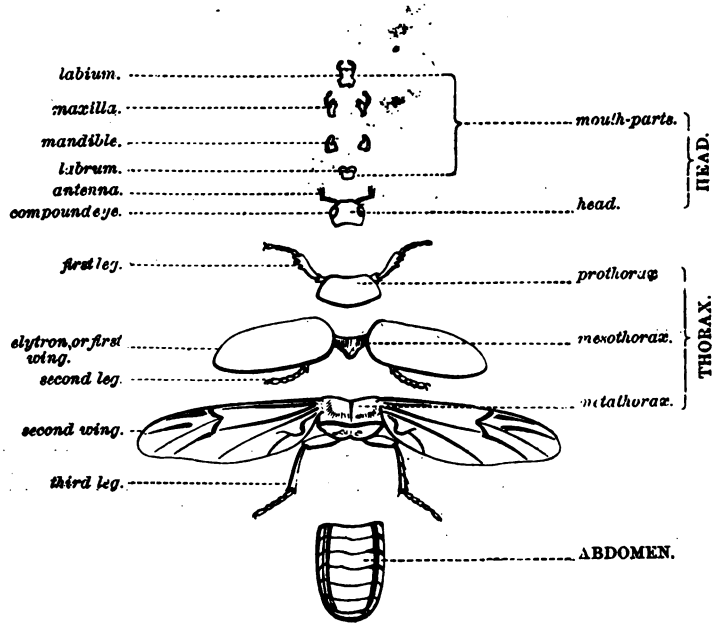


Fig. 5.—Division of body; separated to show parts.

adult insect is still very young and has only shortly left the pupa. The slender feelers or *antennae,* elbowed in the middle, arise from the sides of the beak, and frequently fit into grooves, so as to be well protected when the beak is inserted into food.

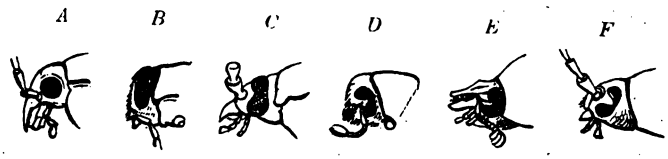


Fig. 6.—Eyes of beetles: *A*, of *Calosoma;* B, of *Chrysobothris;* C, of *Prionus;* D, of *Tomicus;* E, of *Geotrupes;* F, of *Tetroplum.*

The compound eyes (Fig. 6) of most beetles are prominent, and are of various forms: round, oblong, kidney-shaped, curved, or in one case even divided in the middle, thus giving the impression that the insect possesses four instead of two eyes (Fig. 7). Each eye is composed of many six-sided facets, varying in number from a few to many hundreds. Some beetles found in caves have

Fig. 8.—*Serrate Antennæ and modifications:* 1, serrate; 2, pectinate; 3, bipectinate; 4, flabellate; 5, plumose; 6, 7, 8, irregularly serrate, approaching the Clavicorn type. After Leconte and Horn.

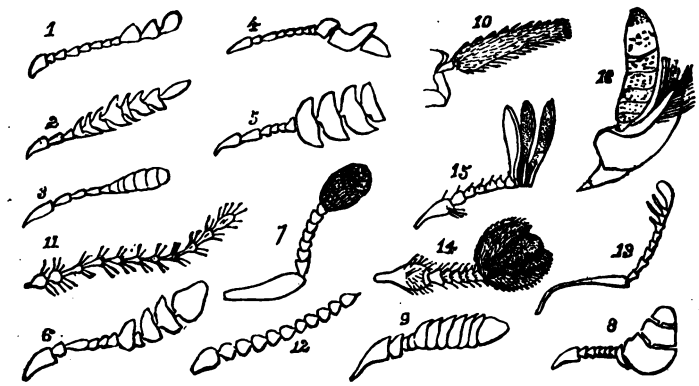


Fig. 9.—*Clavate Antennæ*, 1-10; *Capillary and Verticillate*, 11; *Moniliform*, 12; *Lamellate*, 13-15; *Irregular*, 16. After Leconte and Horn.

no eyes at all. *Ocelli,* or single eyes, do not often occur, though some beetles have two or even only one *ocellus.* The compound eyes of snout-beetles are usually small and round.

The feelers or antennæ of beetles possess various forms, some of which are exceedingly singular and beautiful, resembling feathers. A number of such feelers are shown in Figs. 8 and 9. To

give space to the numerous sense-organs located in them, the feelers, usually composed of eleven joints, are either lengthened out very much , are feather-like, or are like the leaves in a book, and in this manner have the entire surface greatly enlarged. The form of the feeler serves to a great extent as a basis for classification, hence its different shapes have received special names, as may be seen by consulting the illustrations.

Like other insects, beetles possess a thorax composed of three pieces, closely soldered together (Fig. 5). In most insects the surface of all three pieces can be seen from above; in beetles, however, only the anterior piece, the usually broad pro-thorax, is visible on the back. The two other pieces are hidden below, with the exception of a small wedge-shaped piece, a section of the meso-thorax, which is termed the *scutellum*. This is, in most cases, plainly visible where the sutures of the elytra join near the posterior margin of the pro-thorax. A study of the illustrations will explain the anatomy better than a mere description. The abdomen joins the thorax by a wide base; the former is in many cases entirely hidden and protected by the wing-covers, hence is rather soft. But whenever these wing-covers are short, then the surface of the abdomen not covered by them is hard and horny, as it always is on the unprotected lower surface. When not covered, the abdomen is not only soft, but also light in color; all exposed parts are darker, and frequently beautified with markings of various colors and patterns.

Besides the wings already mentioned the adult beetles have as organs of locomotion six legs, which vary greatly in size and shape, as may be seen in Fig. 10. Beetles which live in water have them adapted for swimming; those that have to run about in search of other insects possess very long legs to enable them to catch their prey. Others again, which live upon plants, have their legs arranged to hold on as tightly as possible, so as not to be blown down by even a heavy wind, and still others, which hide in the ground, have at least their front legs so arranged that they can burrow with great ease. In fact, by looking at the legs of a beetle the observer can soon judge what the habits of that insect are. In most cases the legs are the principal organs of locomotion, and only in a limited number of beetles are both legs and

wings used with equal facility. At all events it is with but few exceptions easier for a beetle to run than to fly, simply because, in preparing to fly, it is forced first to lift the wing-covers out of the way to permit the folded true wings to come into action. Whoever has watched a June-bug, which, attracted to the light, had dropped upon a smooth table, and has seen it try to escape by flight, has also noticed how awkward it is, and that it has first to crawl upon some elevated object to be able to unfold the true wings at all. First the heavy wing-covers are lifted right over the head, then the true wings are unfolded, and after a sort of pumping mo-

Fig. 10.—*Natatorial Legs*, 1-2; *Fossorial*, 3. *Tibiæ:* unguiculate, 4; mucronate, 5; closed corbels, 6; open corbels, 7. *Tarsi:* lobed beneath, 8; lobed and with onychium, 9. *Claws or Ungues:* pectinate, 10; serrate, 11; toothed, 12; toothed and serrulate, 13; cleft, with equal movable parts, 14; unequally cleft, 15; bifid also toothed, 16; cleft and divaricate, 17; connate at base, 18; with membranous appendages, 19; chelate, 20. After Leconte and Horn.

tion the beetle eventually flies away, perhaps against the lamp to repeat the ludicrous performance over and over again. The legs of adult beetles are horny, and usually very strong. Each is composed, as may be seen in the illustrations, of a number of joints, i. e. the *coxa, trochanter, femora, tibia and tarsus.* The number of joints in the tarsus or toes—if we can call such organs arranged lengthwise by such a name—varies from three to five, the last one terminating in most cases in a pair of sharp claws. The classification of beetles depends largely upon the number of such toes, which are, however, not always easily seen. In some cases the terminal two are soldered together, or the last one is sunk in the one above it, and sometimes it requires close study to detect the real number of these useful organs. The lower surface of some

or of all the tarsi, is clothed with small *pulvilli,* looking like velvet, which are used almost like sucking disks to enable its owner to adhere to smooth surfaces.

The beetles undergo a complete metamorphosis. The eggs, usually soft, white or colored, are deposited by the mother upon or near the food required by the young. These eggs soon hatch into larvæ, which are commonly called "grubs," as, for instance, the well-known "white grub." Other larvæ are covered with a thick integument, as the young of our common click-beetles, best known by the name "wire-worms." Most of the larvæ are soft and clumsy looking objects, with darker and horny heads, and three pairs of rather awkward looking, sprawling legs on the first three segments of the body, the *thoracic segments.* No *false legs,* as we have them in the caterpillars of the butterflies and moths, are found, but in many cases there is a sort of *pro-leg* on the last joint of the body. The name pro-leg is rather poorly chosen for an organ found in such a position. Sometimes the larvæ possess one or two rows of fleshy projections or tubercles along the sides, or on the upper or under surface, by means of which they can move in tunnels in the ground or elsewhere.

The larvæ of aquatic beetles possess numerous oar-like organs along their sides, which assist them in swimming about. But all larvæ of beetles which live enclosed in wood or fruit, upon which they feed, have no legs at all, simply because being surrounded by plenty, they have no use for them. As a general rule larvæ of beetles which have to be active in searching for food, or which have to cling tenaciously to food obtained, whether it consists of leaves or living insects, have longer and stronger legs well adapted for such purposes. As all growth of a beetle takes place in the larval stage, the larvæ have to eat much, hence are always hungry. They have to take food not simply to grow, but also to form and to store up material for the future organs possessed by the adults alone, and not found in the larvæ themselves. Such larvæ have to throw off their old skin from time to time to enable them to reach their full size, since their skins can not grow. After a number of such changes or molts, the greedy grub has reached its full size, and is then filled with a large amount of fatty material, a store of surplus food. It now changes to a pupa. This

change takes place in many ways, which will be mentioned later, when describing the different noxious insects.

The pupa can no longer move about, but is helpless, and does not take any food. In this condition it already shows all the external organs of the future beetle, but all of them are still enclosed or encased in separate sheaths. Such a pupa is called an *obtected* pupa. While apparently quite inactive, wonderful changes are being silently wrought, and all the stored-up food is being utilized for this purpose. At last the pale, almost white pupa becomes darker and darker, and the colors of the future beetle commence to show themselves through the semi-transparent pupal skin, which eventually ruptures, and a weak beetle with wings still small appears. The wings soon harden, the other members stretch themselves to their full length, and the adult can now enjoy life and liberty. At first quite weak and pale, it soon becomes strong enough to eat, court, mate, and die.

As a general rule beetles remain in the egg-stage but for a few days; as larvæ they eat and grow from a few weeks to several years. The pupal stage also generally lasts but a short time; the adults in most cases are short-lived, but others hibernate as perfect beetles.

Beetles and their larvæ feed upon all kinds of vegetable and animal substances; some may eat parts of the rarest flowers, others enjoy the rank-smelling carrion; some eat fruits of all kinds, and even the most pungent spices do not escape their hungry jaws. Still others are decided cannibals and eat other insects. Notwithstanding their immense numbers, the order as a whole is not very destructive, at least not in a state of nature. As a general rule the wood-boring kinds prefer sickly or dying trees and thus they act as scavengers, and by removing the dead material make room for new growth. Many, if not most insects of this order, feed upon plants that are of no use to man, and they even injure or destroy weeds, hence can become our friends. But those kinds that devote their attention to eating plants we grow for our own use, or which destroy useful timber or manufactured goods, or which invade our houses to eat material we wish to use ourselves, all these are our enemies, and have to be treated as such. Especially is the grower of fruit greatly troubled by such insects,

and it will be the aim of the following pages to describe the noxious kinds, illustrate them, tell about their life-histories, and give the most approved methods for killing them or for preventing their ravages in other ways.

The beetles discussed in these pages are all, or nearly all, either directly injurious or beneficial. They are arranged not according to their food-plants, but according to the classification of beetles, so that those interested in such matters may also find something of interest to them.

As far as a classification of beetles is concerned, it would of course be impossible to give one that would include all the 11,000 beetles found in the United States, or even those occurring in Minnesota alone. Nor is it the office of the entomologist to give one in these pages, his main object being to describe beetles injurious to fruit-producing plants, and to give the proper remedies against them. For this purpose no attempt will be made to give even a description of all the families that compose the Order of Coleoptera, and the reader will understand the reason when he learns that the beetles of North America, exclusive of Mexico, are arranged in about eighty distinct families, representing upwards of seventeen hundred genera.

Our recognized authorities in this order of insects make the following primary divisions:

BEETLES.

(Order *Coleoptera*).

I. *Coleoptera* (Typical or True Beetles), in which the mouth-parts are all present, and in which the front of the head is not elongated into a beak or rostrum.

1. *Isomera* (Similar joints). The beetles contained in this division have, with rare exceptions, the same number of tarsi in all their feet.

A. Adephaga (Carnivorous beetles). These beetles possess thread-like feelers with distinct and cylin-

drical joints. Here belong the Tiger-beetles, Ground-beetles, Carnivorous Water-beetles, Whirligigs.

B. *Clavicornia* (Club-horns). These beetles have the feelers thickened gradually or abruptly toward the tip. Here belong the Burying-beetles, Rove-beetles, Lady-bugs, Carpet-beetles.

C. *Serricornia* (Saw-horns). These beetles have the feelers toothed or serrated. Here belong the Snapping or Click-beetles, the Saw-horned Borers, the Fire-flies, the Soldier-beetles.

D. *Lamellicornia* (Leaf-horns). These beetles have the knob of the feelers composed of several leaf-like or blade-like parts, which can be closed together at will. Here belong the Stag-beetles, "Tumble-dungs," May-beetles, Flower-chafers, Rhinoceros-beetles.

E. *Phytophaga* (Plant-eaters). Most of these beetles possess thread-like feelers, which are frequently very long, or shorter and slightly thickened towards the tip. The fourth and fifth joints of the tarsi are consolidated, and the former is minute, and sometimes difficult to detect. Here belong the Long-horned Borers, the Leaf-feeding beetles, the Seed-beetles.

2. *Heteromera* (Different joints). The beetles contained in this division have five-jointed tarsi in each of the front and middle legs, and only four in each of the last pair.

This section requires no division into tribes. Here belong Oil-, Blister-, and Meal-beetles.

II. *Rhynchophora* (Snout-beetles), in which the front part of the head is more or less drawn out into a beak or rostrum; the labrum is not distinguishable, and the palpi are reduced to minute points without joints.

In this sub order belong a number of families, some containing but a very few genera or even species. Here belong the Broad-snouted beetles, the True Snout beetles, such as the Nut-weevils, the Rice and "Bill-bugs," the Leaf-rollers, and the Bark-beetles.

COLEOPTERA (TRUE BEETLES).

Among the true beetles we possess a large number of friends, and, as it is just as important to know our friends as to know our foes, so as to protect the former and combat the latter, a description of them should find a place in these pages.

I. ISOMERA. (*Similar joints*).

A. CARNIVOROUS BEETLES.

(*Adephaga*).

Beetles of this group are numerous, and a number of species will be described and illustrated. Most of these insects prey upon others, and destroy large numbers of plant-eating insects. A few of them have, however. a mixed diet, and also eat the pollen of flowers, seeds of grasses, grains still in the milky state, and similar substances. Such exceptional beetles can usually be recognized by their form, which is quite stout and heavy. In fact they must have more space in their stomach, and must have longer intestines to accommodate such bulky food than beetles that live on the concentrated food obtained by eating other insects. But the former also eat insects, when not as adults they do so as larvæ; hence they are friends, though they are not so beneficial as those having a strictly animal diet. A number of families belong to the Carnivorous beetles.

FAMILY TIGER-BEETLES.

(*Cicindelidae*).

These are most active beetles, which use wings and legs with equal rapidity and facility. They are active only during the sunny and warm portions of the day, and are so swift in all their motions, either in flight or running, that they are not readily seen. During the night, and also during dark and rainy days, they hide

under loose pieces of bark and flat stones, or burrow in the sand, sometimes to a depth of four or five inches. A few species are strictly nocturnal, but some others are found running about in the sun during the day and may also be attracted to lights at night.

As a general rule tiger-beetles prefer sandy spots or sandy roads, over which they run very swiftly, and as their senses are very alert, they discover approaching persons very soon, and escape molestation by running or flying away. But they run or fly but a short distance, never leaving the sandy spots, so that the eyes of the observer can follow their motions, and he can approach closer by taking the proper precautions. Their alertness is shown by the fact that when settling again after a short flight they almost invariably face the intruder. They are of medium

Fig. 11.—Tiger-beetles, all stages. Enlarged. After Brehm.

size, frequently less than three-fourths of an inch long, and possess brilliant metallic colors. Their wing-covers are usually spotted with white. Their popular name, "Tiger-beetles," is a well-chosen one; they are veritable tigers on account of their ferócious habits, their swift movements, the markings on the elytra, and the stealthy manner in which their larvæ lie in wait for insects.

The illustrations (Figs. 3 and 4) give both upper and under surface of one of these beetles, dissected in part to show the details; Fig. 11 shows the earlier stages of this beetle. The larvæ of tiger-beetles are as ugly as the mature insects are beautiful; they live in vertical holes in the ground, usually in places similar to those in which the adults display themselves. Such burrows are often a foot or more deep, and are not infrequently found in sunny spots in an orchard. Such larvæ, with large and dirty colored heads and equipped with immense jaws and long and sprawling legs, usually watch at the mouths of their burrows for any approaching insect, and they are always ready to seize it when it walks over such living traps, hidden by the watchful larvæ, which almost entirely fill the entrances with their formidable heads. In addition to its six legs the larva possesses another peculiar organ, which assists it in climbing up and down in its burrow. This is a hump on the fifth abdominal segment, upon which are

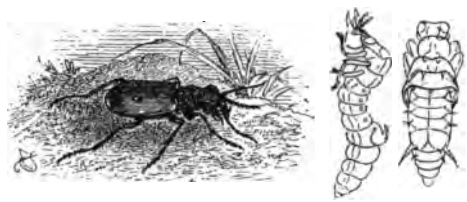


Fig. 12.—Tiger-beetle, adult, larva and pupa. After Brehm.

two hooks curving backwards (Fig. 12). The larva thus anchored can not readily be drawn out of its trap by the contortions even of large caterpillars that it may have caught. If captured the caterpillar is dragged into the burrow and is eaten at leisure. When we thrust a straw into one of these traps, and then dig it out with a spade or trowel, we usually find the ferocious hermit at the lower end of the burrow, biting savagely at the straw. Sometimes by introducing a straw we can even pull the vicious larva to the surface, since it is so tenaciously fastened to it that it will act like a bulldog tearing at the throat of another dog. By singing into the holes the larvæ are sometimes induced to

come to the entrance of the pit, not to listen to the sweet sounds produced by the inquisitive boy, but to capture the imaginary intruder. The pupa is also found in such burrows; it is of the usual form, foreshadowing the future insect.

Tiger-beetles, and especially their larvæ, are sometimes very beneficial to owners of fruit-producing plants. The writer has in one instance counted nearly a hundred such burrows in the vicinity of a single large and isolated apple-tree, and many fat caterpillars were devoured by the always hungry trap-dwellers. Of course much of the food consumed consists of insects habitually running over the ground.

FAMILY GROUND-BEETLES.

(*Carabidae*).

This popular name is in the majority of cases a good one, as most of the beetles belonging to this family are found upon the surface of the ground in their adult stage. It is a large family, containing, in the United States, about 1,200 species. Yet, notwithstanding this large number, they are not seen as often as might be expected, simply because the great majority of them are nocturnal in their habits. This accounts for their dark color. Others, however, are very brightly colored, some are metallic, some blue, green, or almost white, the color depending on the general color of the surroundings. By this is not meant that the insects have the power of changing their color, like a tree-toad, but that they are only found in such places as blend with their colors.

Some of these predacious beetles may occasionally be seen running over the ground in gardens, orchards, and in fields, or they may be seen even in the trees themselves, searching for food. But most of them hide during the day under stones, boards, or dead leaves, and they do not leave these shelters until night. Like the tiger-beetles, the ground-beetles possess thread-like feelers, which taper gradually towards the tip, and are composed of

joints which are nearly uniform in thickness throughout their length. The legs, with but few exceptions, are adapted for running, which some of them do with amazing rapidity. In fact all the senses of these beetles are very acute. Ground-beetles are distinguished at a glance from the tiger-beetles by having their heads narrower than the pro-thorax. They depend more upon their legs for locomotion than upon their wings, and but very few fly readily. Some have lost their true wings almost entirely, and in such cases the elytra are soldered together at the surface on the back.

Fig. 15.—*Calosoma frigidum*. Kirby. Original.

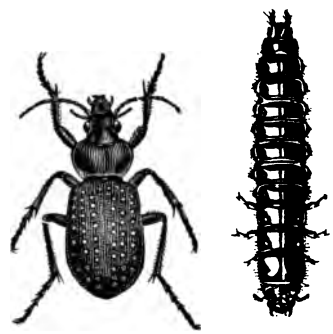


Fig. 13.—*Calosoma calidum*, Fab., and a larva of another species.

The larvæ (Fig. 13) are mostly long, flattened grubs, with a body of almost equal breadth throughout. The latter is usually protected on top with horny plates, and ends in a pair of conical and bristly appendages. Most of the larvæ exist in the same obscure situations in which the adults live, and they burrow just beneath the surface of the earth. Here they destroy large numbers of the soft leaf-feeding insects, which have entered the ground for transformation. Like the adults, they are predacious. Others may, perhaps, also feed upon some vegetable food like the adults, but they cause no losses of any great economic importance. When fully grown they transform to pupæ under ground, where they have formed small cells for this purpose. Soon afterwards the pupæ change from almost white to the distinguishing colors of the adults, and leav-

ing the old pupal skin behind, the young beetles reach the surface.

Among the most useful of the ground-beetles several deserve special mention, since they help us greatly to reduce certian injurious insects. The Caterpillar-hunter, (*Calosoma scrutator* Fab.), is one of them. It is one of our largest and most beautiful ground-beetles, having metallic green wing-covers, margined with reddish; the rest of the body is marked with violet, blue, gold, green, and copper. It is shown in Fig. 14.

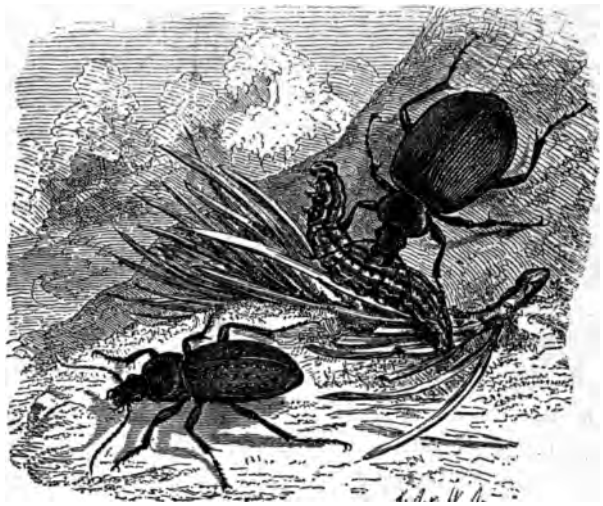


Fig. 14.—*Calosoma*, similar to *C. scrutator*, Fab., below a *Carabus*. After Brehm.

This insect ascends trees in search of caterpillars, and wherever the tent-caterpillars, frequently so destructive in Minnesota, are found in large numbers, the beetles will make war upon them; but few other insects care to attack and eat such hairy worms. It is a pleasure to a person interested in the well-being of his trees to watch this beautifully armored warrior catch a caterpillar, and holding the squirming object in its powerful jaws, suck out its life-blood. The empty skin of the victim is dropped, and another unlucky worm is caught and treated in the same man-

ner. The appetite of the beetles is truly without limit, and they eat all day if they have an opportunity to do so. It is too bad that they are not more numerous in all our orchards and forests in the north; they are confined to the more southern parts of the state.

Another species of caterpillar-hunters, (*C. frigidum* Kirby), is, however, very numerous in the northern part of Minnesota. It climbs trees as well as the one described, but it is of a black color, (Fig. 15). Wherever canker-worms abound large numbers of these beetles congregate, and they climb trees in search of them. They detect such worms some distance away, and rushing over twigs and leaves, frequently succeed in catching them before their victims have an opportunity to drop and hang suspended by silken threads. It is amusing to observe, if unsuccessful, how the baffled hunters try to grasp such a thread with their front feet in which not infrequently they succeed. Others are stationed below the tree, and many of the worms that descend from the defoliated branches to enter the ground for pupation are caught before doing so. The larvæ of both the above described beetles are also equally active and beneficial. Though they do not climb trees they do good work above and below the surface of the soil, always hunting about to find some insects to eat. Another beetle of the same genus, the "Fiery Hunter" (*C. calidum* Fab.), is frequently seen searching for cut-worms and other food in the grain-fields in our open prairies. It is readily recognized by its black wing-covers with rows of reddish or copper-colored pits. It is illustrated in Fig 13, with its larva.

When we turn over loose stones and boards lying about the edges of fields and orchards, we frequently discover rather large black beetles having thorax and wing-covers bordered with blue. They seem to be very slow in their actions, and do not usually attempt to escape. But not everyone likes to pick them up with the fingers, as they have a sort of dangerous look about them, possessing very formidable jaws. These insects are very useful, and locust-infested fields contain them in large num-

bers. The writer has counted a great many hundreds in a small space in a ditch adjoining a field invaded by the army-worms. Here they were resting from the night's labor of eating such worms.

Fig. 16 shows one of the largest kind, the Western *Pasimachus californicus* Chd., and Fig. 17 a related smaller species, entirely black, the *Clivina impressifrons* Lec.

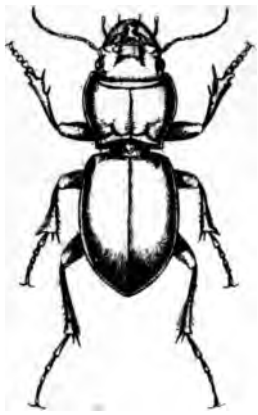


Fig. 16.— *Pasimachus californicus*, Chd. After Leconte.

Fig. 17.—*Clivina impressifrons*, Lec. Enlarged. After Forbes.

To the carnivorous beetles belong also the "Bombarding-beetles," (*Brachinus* species), which have a red head, thorax and legs, with dark blue or greenish-blue wing-covers; they are quite abundant in some moist places, where they hide under loose stones. Such beetles (Fig. 18) are frequently mailed to the office of the Entomologist to find out their names and life-history; but thus far they have never been received labeled "Kissing-bugs," although almost all other queer looking or queer acting insects have been received as such. These bombarding-beetles possess little sacs at the hind end of their bodies, in which a bad-smelling fluid is secreted, which is used as a means of defense.

In fact most of the Carabidæ are well protected by strong odors, as those handling them have found out to their sorrow. But in this case the beetles squirt the nasty fluid at their enemies, and as it changes to a gas on contact with air, it looks as if the beetles

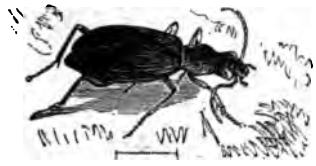


Fig. 18.—*Brachinus* species. Enlarged. After Brehm.

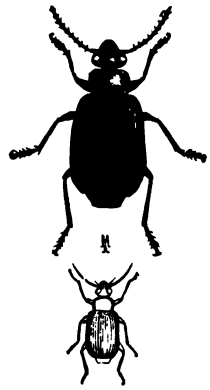


Fig. 19.—*Lebia grandis*, Hents. Division of Entomology, U. S. Department of Agriculture.

were shooting in a wrong direction. A puff of smoke and a faint pop is the result of such an explosion. This fluid colors the fingers a persistent red, which shows that it is of an acid nature. Of course this sort of defense is very effective, and we may call these beetles "six-legged skunks."

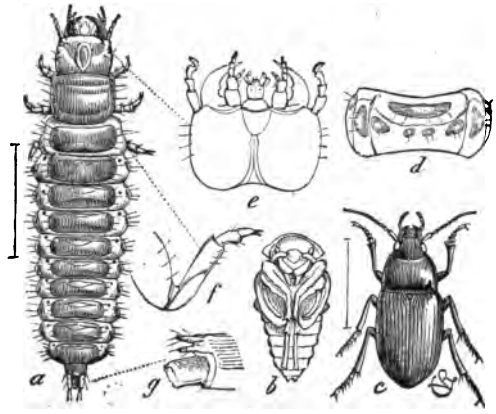


Fig. 20.—*Amara obesa*, Say. *a*, larva; *b*, *pupa*; *c* adult *d*, *e*, *f*, *g*, details of larva. After Riley.

A similar beetle, illsutrated in Fig. 19, is the *Lebia grandis* Hentz. This similarity extends, however, only to the coloring of the insect, not to its method of defense. The beetle is very useful, and sometimes becomes quite numerous in potato fields infested with the Colorado potato-beetle. It eats their eggs as well as the young worms; other small soft-bodied insects are also pleasing to its taste.

There are other useful beetles belonging to this division, which deserve a passing notice. In fields filled with eggs of locusts we find numerous oval-shaped black beetles (*Amara obesa* Say), Fig.

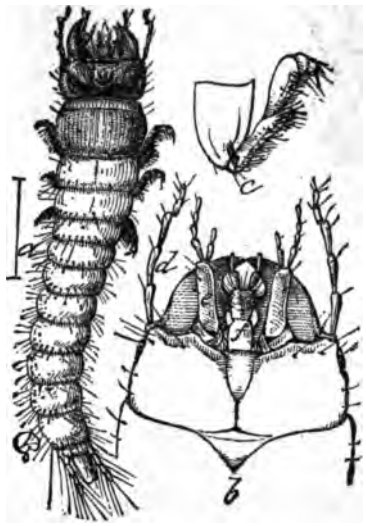


Fig. 21*. *Harpalus herbivagus*, Say. *a*, larva; *b*, head of same. Enlarged. After Riley.

20 which run about very diligently in search of food. They deposit eggs in the ground, from which yellowish-white worms, also shown in the illustration, hatch in due time. These worms search for the eggs of locusts, and devour immense numbers of them. The larvæ of another beetle, shown in Fig. 21, are also found in similar places, and also do similar good work. They transform in time into black beetles, the *Harpalus herbivagus* Say. A related beetle, the *H. pennsylvanicus* DeG., which is frequently

*In case the illustrated is enlarged, the true size is usually given by a fine line near the figure.

found in orchards eating the larvæ of the codling moth and of the plum-curculios, is also shown in Fig. 22.

It would take too much space to even mention all the beetles belonging here. Most of them are useful, though a few may occasionally cause some damage. The insect illustrated in Fig. 23, (*Agonoderus pallipes* Fab.), is one of them, as it sometimes eats into the sprouting seeds of corn. This insect is at times exceedingly common, as people who have strong electric lights in

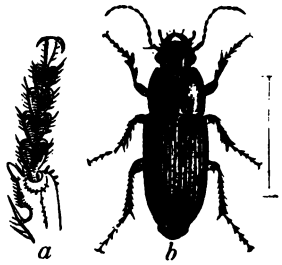


Fig. 22.—*Harpalus pennsylvanicus*, De G. *a*, anterior tarsus and part of tibia showing notch; *b*, beetle; *A*, larva, reduced size; *B*, head; *c-j*, details. After Riley.

Fig. 23.—*Agonoderus pallipes*, Fab., and beetle inside of corn. After Riley.

front of their houses are apt to find out. Immense numbers of them and of other insects are attracted, and sometimes they are so numerous as to cover the sidewalk with their dead and dying bodies. Rooms with open windows, and illuminated with lamps, are sure to attract multitudes of them; they seem to be of a decidedly inquisitive nature, as they run over our bodies, possibly in search of hiding places, and in doing so cause a sensation very far from being pleasant.

In a general way nearly all such insects are either beneficial, or at least harmless, hence are our friends and should be known as such.

FAMILY PREDACEOUS WATER-BEETLES.

(*Dytiscidae*).

Predaceous Water-beetles are simply ground-beetles modified to live in water. They have the same blood thirsty instinct

as their relatives in drier places. Such beetles are also very numerous, and are readily observed when we quietly approach a pool of stagnant or standing water. We can detect their oval and flattened bodies hanging head downwards, with the tip of their abdomen at the surface of the water. When disturbed they dive, and in doing so carry with them a bubble of air, which looks like a liquid drop of silver, and which is utilized to sustain respiration until the beetle feels safe again and rises to the surface. Such beetles are well adapted for swimming, possessing a boat-shaped body, usually quite polished, and having their long hind legs broadly flattened and fringed with stiff hairs, so that they can be used as oars. Such a leg is shown in Fig. 10, and it will be noticed how admirably it is adapted for swimming. The feelers of such beetles are long and thread-like. The males of

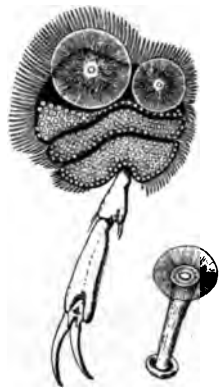


Fig 24.—Sucking disk of male *Dytiscus*. Highly magnified. After Miall.

some kinds possess a very remarkable sucking-disk (Fig. 24), which is produced by dilating the first three pairs of the front tarsi; the females sometimes have the elytra furnished with deep furrows. Both structures are of use during the mating season. All the water-beetles, and still more so their dangerous looking larvæ, which possess powerful scissor-like jaws, kept in constant motion, are savage and greedy, feeding upon tadpoles,

small fish and aquatic insects. They have no direct bearing upon horticulture, except, perhaps, by destroying large numbers of the larvæ of mosquitoes, which annoy fruit-growers as well as other people. The illustration, (Fig. 25), gives an idea of the form of such beetles and their larvæ. The larvæ, though aquatic, leave the water when ready to change to pupæ. This is performed in an earthen cell made for this purpose in adjoining dry soil.

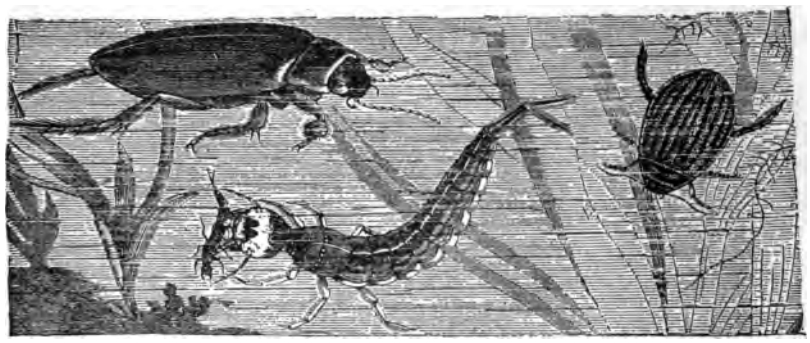


Fig. 25.—Carnivorous Water Beetles. After Brehm.

FAMILY WHIRLIGIG-BEETLES OR "APPLE-SMELLERS."

(*Gyrinidae*).

This family is mentioned here not because its members smell like apples, the act which gives it its name, nor because they are fond of that fruit, but simply to show how certain organs can be modified for specific purposes. In these beetles we find that the eyes are completely divided by the margin of the head, so that they appear to possess the unusual number of four eyes (Fig. 7); they are also remarkable for their long front legs, which are used for grasping their food. The other legs seem to be absent, but this is not so, as they are simply folded up in the smallest possible space when not in actual use. Every one knows these social black and shiny beetles, small in size, which, however, sometimes crowd together in such numbers on the surface of our

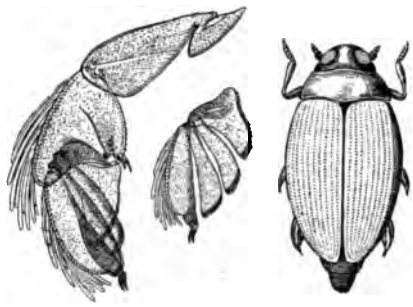


Fig. 26.—*Gyrinus marinus*. Gyll. Hind leg and tarsal joints of same separated and extended. Highly magnified. After Miall.

lakes, especially in quiet water near the shore, that they cover many square yards. If disturbed, all dart away, tracing graceful curves on the surface of the water. The legs and the adult insect are illustrated in Fig. 26.

B. CLUB-HORNS.

(*Clavicornia*).

Club-horned beetles are very numerous, but the character expressed by the term "club-horns" is not always easily detected. These beetles are divided into numerous families (32), and some of them are of very great benefit to orchardists. Most of them, however, are scavengers, and subsist upon dead or decaying material. Some live in water, others are inhabitants of ant-nests, some prefer dung as food, others dead fungi and wood, or woolen garments and dried meat, and even collections stored in museums do not escape their hungry jaws. One family at least enjoys nothing better than leaf-lice and scale-insects, the great enemies of our fruit-producing plants. It is impossible even to mention the names of the numerous families of beetles belonging here, and only a very few of the more destructive ones will be given, so that something about the classification of beetles may be learned.

FAMILY WATER-SCAVENGER BEETLES.

(*Hydrophilidae*).

These beetles, some of which are quite large and well known, as they are attracted to the electric lights in our streets in large numbers, even when a long distance away from ponds and lakes, are found in stagnant water, where they either cling to the plants growing on the bottom of such pools, or move about in a peculiar manner, not swimming with strokes of both hind legs, as the aquatic carnivorous beetles do, but by moving the

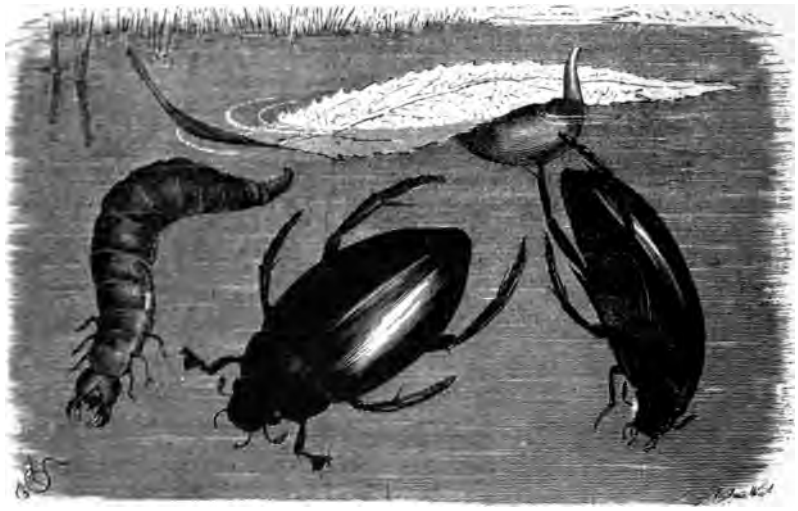


Fig. 27.—*Hydrophilus*, adult, larva and peculiar egg-mass. After Brehm.

legs alternately as if walking. They possess short club-shaped feelers well hidden beneath the head, so that they are not readily detected. Their food is mostly composed of decaying material, but if they have an opportunity to catch living prey they are not slow to eat it as well. They breathe by carrying a film of air on the lower side of the body, which gives them a beautiful silvery appearance. When they need a fresh supply of air they

come to the surface of the water with their heads first. The illustration, (Fig. 27), shows some of the stages of the largest of these beetles.

FAMILY CARRION-BEETLES.

(*Silphidae*).

These well known beetles devote all their attention to destroying dead animal matter, even of the most putrid kind. A few are, however, partly vegetable feeders, and at least one is known in Europe as being very destructive in gardens. Most people have seen some of them at work burying dead mice and birds, for which reason they are called "burying-beetles" (Fig. 28). They are black, with large spots or bands of bright orange yellow; some are polished, others have a thorax densely covered with yellow hairs. If such beetles discover a small dead animal, they immediately remove the soil beneath the same, and

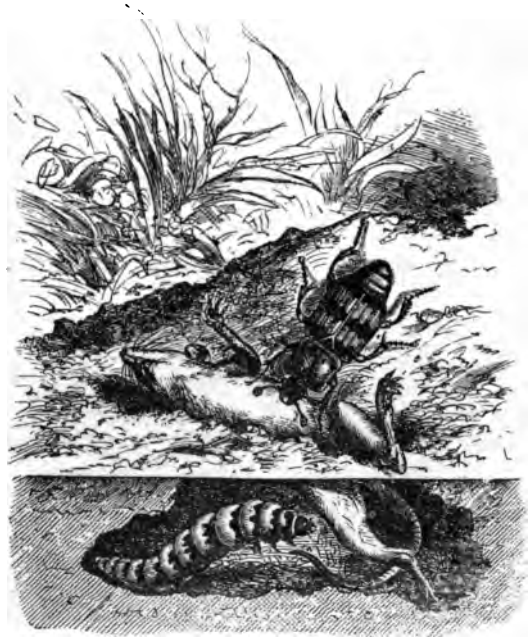


Fig. 28.—*Necrophorus* burying mouse, and larva. After Landois.

usually many individuals are seen working together and in harmony. If the carcass has been covered up, the females deposit their eggs upon this store of food, and now leave; the larvæ feed upon the buried putrid material. The strength of such beetles is remarkable, as is shown by the fact that two of them have been observed to roll a large dead rat several feet, in order to have it rest upon a soil fit for burying. The illustration (Fig. 29), shows another of these interesting beetles, belong-

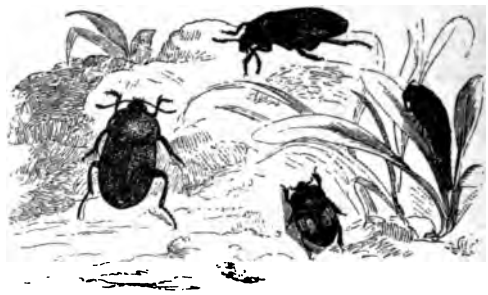


Fig. 29.—*Silpha* and *Hister*. After Brehm.

ing to the genus *Silpha*, the members of which are all very flat. The full-page illustration shows many of the different kinds of scavenger-insects upon a dead mole.

FAMILIES. SCYMAENIDAE AND PSELAPHIDAE.

These comprise very small beetles which are usually found in ant-nests. They resemble ants in shape and color, and are

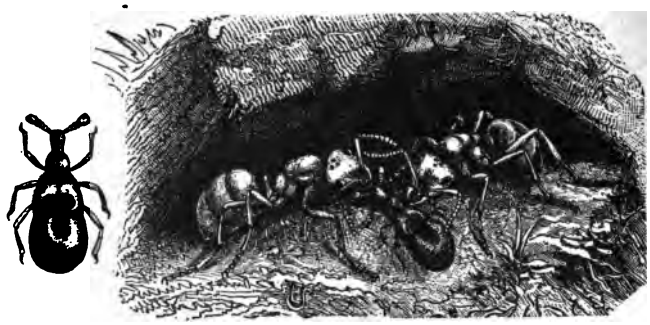


Fig. 30.—*Claviger* petted by ants. After Brehm.

A feast for scavenger insects. After Brehm.

kept, like leaf-lice, for the purpose of furnishing sweet food for their captors, the owners of the nests. Some of them are entirely blind, and most of them are taken care of by the ants, who even feed them. They are of no economic importance. Fig. 30 shows one of these peculiar insects tended by ants in one of their subterranean vaults.

FAMILY ROVE-BEETLES.

(*Staphylinidae*).

This is a very large family of small beetles with a very elongated slender body and very short wing-covers (Fig. 31). But notwithstanding the short elytra the beetles possess ample

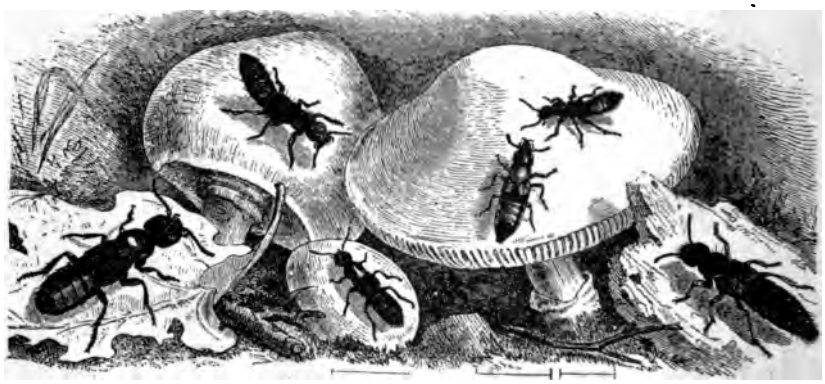


Fig. 31.—Different kinds of *Staphylinidæ*. After Brehm.

true wings. Some of the larger species, measuring more than half an inch in length, assume a very threatening aspect when closely approached with the finger. Their abdominal joints being very movable, they raise the last unarmed joints, which are frequently of a contrasting color, being yellow or red, as if to sting, and in this way they are well able to scare those that do not know them from the wasps which they imitate. Nearly all these beetles are beneficial, as they are scavengers, feeding upon decaying animal and vegetable matter.

A few of them are found in blossoms, very likely eating pollen; but as flowers produce an abundance of this material the beetles cause no damage, on the contrary, they may even be useful by carrying pollen from flower to flower, thus cross-fertilizing them.

FAMILY LADY-BUGS.

(*Coccinellidæ*).

These very beneficial insects are the best friends of our orchardists, as nearly all of them seem to devote their time, both as larvæ and as adults, to destroying the injurious leaf-lice and scale-insects. The beetles are rather handsome, almost always of a bright red or orange color, with intense black spots; or they are polished black with red spots. The bright colors protect them to a large extent against insect-devouring birds, since it shows them that the food is not good to eat, they having learned by experience that such bright colors coming from such insects indicate nasty odors or, perhaps, a nasty taste. At all events insects marked by such showy and conspicuous colors are not often eaten. The bodies of lady-bugs are usually of an oval or hemispherical form, very convex, and almost flat below. The short

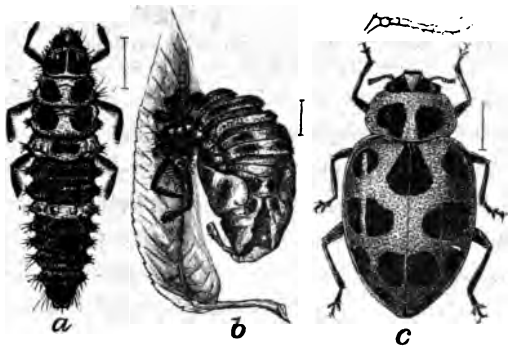


Fig. 32.—*Megilla maculata*, De G. After Division of Entomology, U. S. Department of Agriculture.

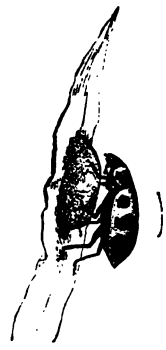


Fig. 33.—*Megilla maculata*, De G.; parasitized. After Division of Entomology, U. S. Department of Agriculture.

feet and still shorter feelers are well hidden beneath the turtle-shaped shell and are not visible unless the beetle is in motion. Beautiful as the adult beetles are, their larvæ are horrible looking objects, having their surface covered with long or pointed spines; others are protected by being covered with fine white down. The pupa is not formed in the soil but inside the larval skin, which splits open at the back, surrounding the pupa like a tight-fitting over-coat with the front not closed by buttons. In other cases the larval skin is forced backwards, and remains as a little crumpled pad about the posterior end. The larval skin in the former case is tightly fastened to the plants, and remains in this position sometimes long after the beetles have left both pupal and larval skins.

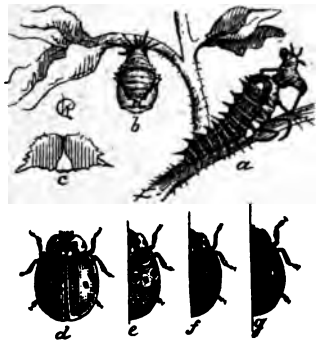


Fig. 37. — *Anatis 15 punctata*, Say. After Riley.

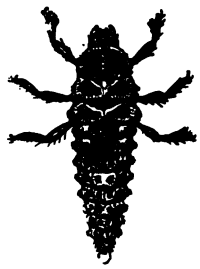
Fig. 34. — *Hippodamia convergens*, Guer. After Riley.

Fig. 35.—*Coccinella sanguinea*, Linn. After Riley.

Lady-bugs are well-known, and may be seen in large numbers upon trees infested with plant-lice and scales. Both larvæ and adults eat these beings very greedily, and destroy immense numbers of them. Without their presence and assistance plant-lice increase so rapidly that in a very short time the plants would be entirely covered with them, and as a consequence might suffer very much, or would even be killed.

As the life-history of all lady-bugs is very similar, it is not necessary to describe in detail all the species found upon our

fruit-producing plants. A number of them have been illustrated, and readers can learn their shape, etc., by consulting the illustrations (Figs. 32-39). The fruit growers of California ought to bless such insects, as they helped them to destroy a most destructive scale-insect which threatened to ruin the fruit-growing interests in that state. For this purpose a lady-bug, (*Vedalia cardinalis*), and several other kinds were imported from Australia, where they were known to kill this scale, and in less than two years the pest was almost exterminated. The "twice-stabbed lady-bugs," natives of the United States, also assisted in the good work, and one of them, the *Chilocorus bivulnerus* Muls, is fairly common in Minnesota (Fig. 38). The "two-



a

d

e

Fig. 36.—*Adalia bipunctata*, Linn. After Riley.

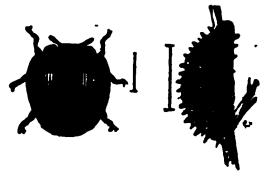


Fig. 38.—*Chilocorus bivulnerus*, Muls., and larva. After Riley.

spotted lady-bug," (*Adalia bipunctata* Linn.), which was rather uncommon until a few years ago, is now found everywhere in our state in many interesting variations; it is the only one of the lady-bugs that here enters houses for hibernation, and is frequently mistaken for the destructive carpet-beetle, and killed on that account. It is a reddish-yellow beetle with a single black spot on each wing-cover (Fig. 36).

Some species of the lady-bugs are so minute that they are barely visible, as is shown in Fig. 39, which shows some of these small black beetles, with their larvæ, in the act of eating the dreaded San Jose scale, yet, notwithstanding their small size, they do much good. All the above-mentioned beetles should be protected, since they are most useful friends.

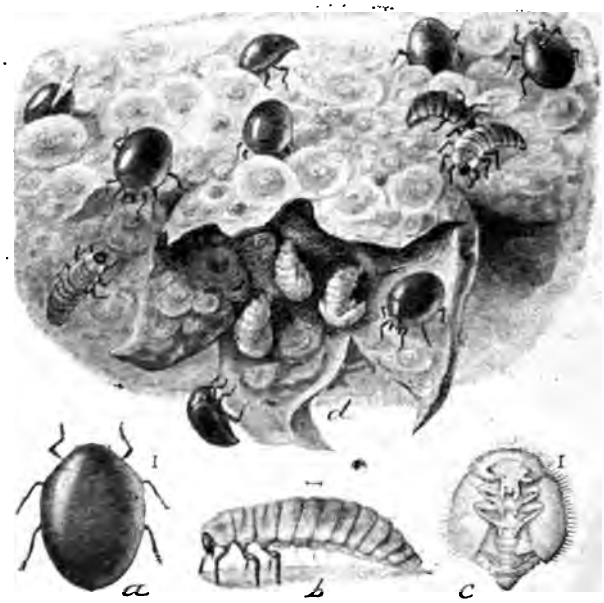


Fig. 39.—***Pentilia misella***, Lec.—*a*, beetle; *b*, larva; *c*, pupa; *d*, blossom end of pear eaten by the *Pentilia*. (After Howard and Marlatt), Division of Entomology Department of Agriculture.

But there is one exception, one black sheep in the flock! This exception is a plant-feeding species (*Epilachna borealis* Fab.), happily not as yet found in our state. But as it will doubtless find its way to our fields we should be on our guard. This lady-bug, both as larva and as adult, feeds upon squashes, cucumbers, and melons. The beetle is yellowish, with large black spots,

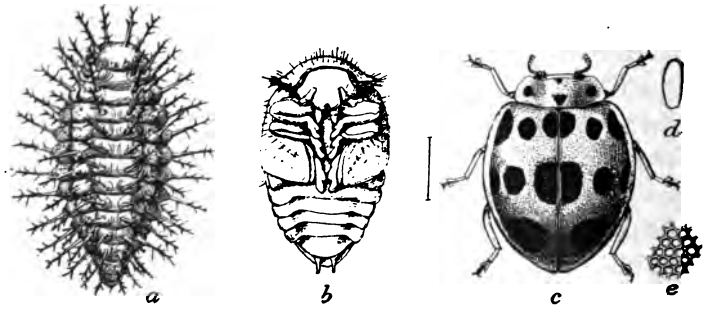


Fig. 40.—***Epilachna borealis***, Fab. After Division of Entomology, U. S. Dept. of Agriculture.

and is not as shiny as the other lady-bugs of equal size, but is covered with a fine pubescence. The larva is yellow, and clothed with forked spines, as may be seen in the illustration (Fig. 40). There is no doubt that in case of necessity, or for lack of proper animal food, some of the lady-bugs will also eat pollen, but their usual food consists of plant-lice, scale insects, and the eggs and soft bodies of other insects.

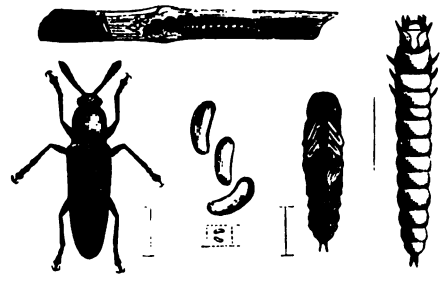


Fig. 41.—*Languria Mozardi*, Lat. After Division of Entomology, U. S. Department of Agriculture.

The families *Endomychidae* and *Erotylidae* also contain a number of brightly colored beetles with long feelers. But none are very common or destructive, with the exception of some beetles belonging to the genus *Languria,* one of which has in the larval state the bad habit of boring in the stalks of clover. It is shown in Fig. 41.

FAMILY CUCUJIDAE.

These beetles, usually of a flat and elongated form, are found under the bark of trees, and are believed to be mostly carnivorous, but others are known to feed upon stored grain. Several species have this bad habit, but the most important one is the "Corn Silvanus" (*Silvanus surinamensis* Linn.), shown in Fig 42. It is a dark brown and flat beetle, with saw-like edges on the pro-thorax. It also feeds on dried fruit. In such a case it can be killed by putting the infested fruit in a tight-fitting wooden box, and by pouring a wine-glass full of bisulphide of carbon in the larger box the fumes thus produced will kill all intruders.

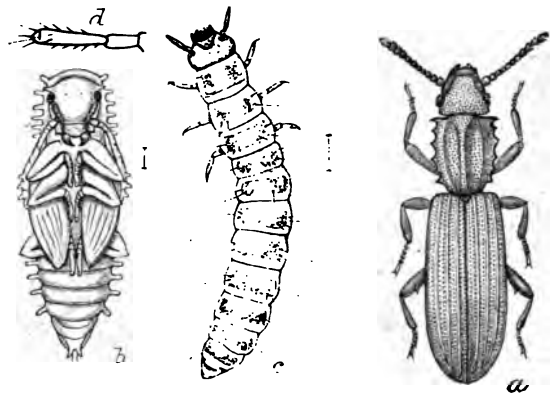


Fig. 42.—*Silvanus surinamensis*, Linn. After Division of Entomology, U. S. Department of Agriculture.

There are many of these and other insects found on dried fruit, since this is palatable to six-legged beings as well as to two-legged ones. The fumes mentioned above kill all insects, without leaving any odor or flavor behind, but whether the infested fruit with the dead insects in it is fit for human food must be decided by the individual who wishes to eat it.

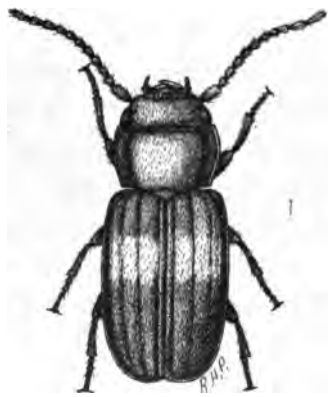


Fig. 43.—*Laemophlæus fasciatus*, Mels. Original.

Another species, the *Laemophlaeus fasciatus* Mels., illustrated in Fig. 43, is found under bark, but is also very common near saw-mills, especially in those in which hard wood is sawed.

In running over persons engaged in mills it will bite, even without provocation, and may cause bad sores. It is a small and flat beetle, of a light brown color, with highly polished wing-covers, with a light space upon each. Related beetles are found also in stores of grain and dried fruit.

FAMILY DERMESTIDAE

(*Larder-beetles; Carpet-beetles; etc.*).

Most of the beetles composing this family feed upon decaying substances, or on skins, furs, and dried animal matter of all kinds. The wing-covers completely cover the abdomen, and are not

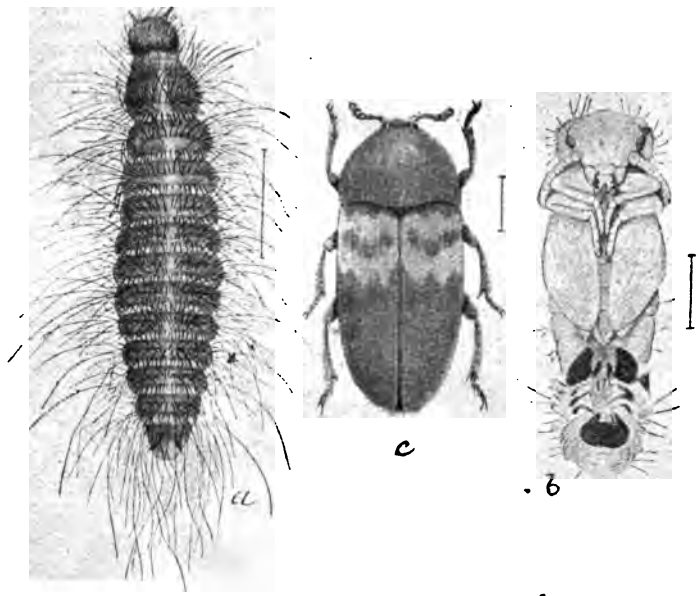


Fig. 44.—*Dermestes lardarius*, Linn. After Division of Entomology, U. S. Department of Agriculture.

shorter than it, as was the case in most of the scavenger beetles mentioned thus far. They are usually small, but few reaching a length of one-third of an inch. They are oval or elongated, ornamented with pale gray, yellow, or white markings formed by minute scales which rub off very easily, and are sometimes

arranged very prettily. Most of the insects pretend to be dead when disturbed, and roll upon their back, on which they remain for a long time. To this family belongs the Larder-beetle, (*Dermestes lardarius* Linn.), which is shown in Fig. 44. Both larvæ and adults enter houses, and for no good purpose, since they destroy stored provisions, especially those composed of animal matter, as smoked meat, hides and feathers. The *Museum Pest* destroys collections, and the *Carpet-beetles* (*Anthrenus scrophulariae*

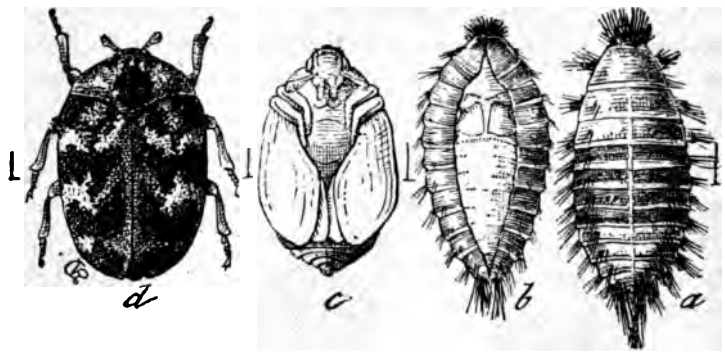


Fig. 45.—*Anthrenus scrophulariæ*, Linn. After Riley.

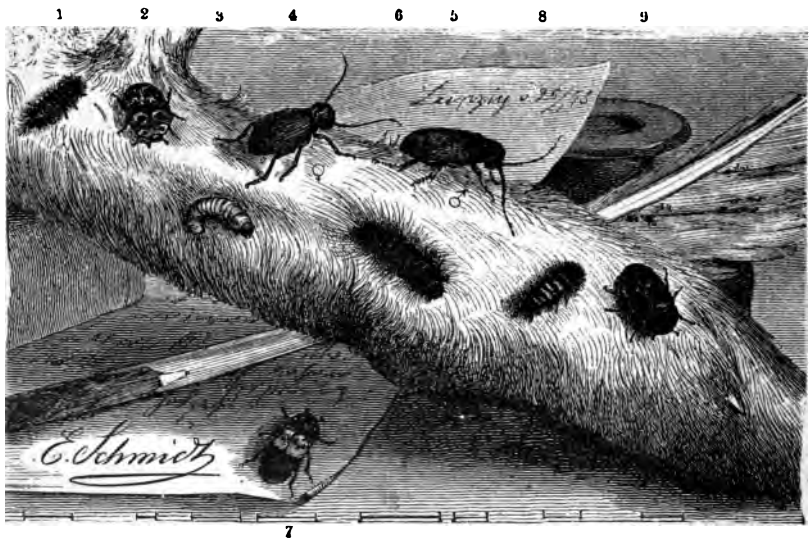


Fig. 46.—*Dermestidæ* and *Ptinus* at work. After Brehm.

UNIVERSITY OF CALIFORNIA

Linn), illustrated in Fig. 45, are well named, since they eat woolen carpets and similar material, often causing great losses. In a state of nature such beetles are useful as scavengers, as they soon remove bad-smelling and unsightly substances. A number of these beetles of similar habits are also shown in Fig. 46.

But there is one exception. One beetle belonging to this family shows better taste by eating raspberries.

THE RASPBERRY FRUIT-WORM.

(*Byturus unicolor* Say).

This sensible insect, about three-twentieths of an inch in length, is yellowish, and is covered with short, silky, gray hair. It feeds on the flowers of the red raspberry, in which the eggs are also laid. Here the larvæ, which are white and nearly naked grubs, hatch, and enter the inside of the berry, where they rapidly grow. When such a berry is picked the culprit is found inside, clinging to one of the sides of its pleasant dwelling place. The beetle is not common enough in Minnesota to be of any great economic importance; it is shown in Fig. 47.

FAMILY HISTERIDAE.

Members of this family of beetles are usually small, short, rounded or angular insects, of a more or less polished black, bronze, or greenish color, although some are brown or marked with red, as the one shown in Fig. 29. The elytra are finely striated or punctured, and do not cover the entire abdomen, but are cut off squarely, exposing the last two segments of the same. These are also very hard, and look like the wing-covers. Below the elytra are ample true wings. The legs, which are adapted for digging, as well as the short feelers, can be hidden in depressions, and if this is the case the entire insect looks very much like a black seed, especially as it also pretends to be dead when captured. Such beetles abound about carrion and other decomposing substances. The whitish and maggot-like larvæ are found in similar material, but occur also in over-ripe fungi, fruit, and under loose bark of trees.

FAMILY NITIDULIDAE.

(*Sap-beetles*).

Sap-beetles are also small, more or less flattened insects, which in most cases have the tip of the abdomen exposed beyond the wing-covers. The pro-thorax is frequently provided with wide and thin margins; the legs are not specialized for digging purposes. The beetles, both larvæ and adults, feed on decaying or fermenting sap, fruit, or fungi; a few prefer carrion, and still others are found among stored grain. They are especially numerous among rotting fruit and vegetables, and about trees that have been injured by bruising, and in such places they crowd together in large numbers to obtain the fermenting sap; beneath stored and over-ripe fruit they also gather.

Fig. 47.—*Byturus unicolor*, Say. After Saunders.

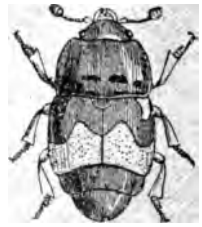


Fig. 49.—*Carpophilus hemipterus*, Linn. After Smith.

A number of these beetles deserve a short description, as they are frequently found about our fruit-producing plants. The *Carpophilus brachypterus* Say (Fig. 48, plate 1), was very common during the last two seasons in the flowers of the apple. Here they enjoyed a meal of pollen, which covered them to such an extent as to hide them effectually. Going from flower to flower, they no doubt do some good, but some also show their appreciation of a good thing by eating holes in the petals, not, however, causing any visible damage, as the petals soon drop off anyhow. Another species, the *C. hemipterus* Linn., is frequently very abundant in stored fruits, and seems to enjoy a box of figs

beyond anything else. It is illustrated in Fig. 49, to show the structure of such beetles, which could not be shown in Fig. 48.

FAMILY TROGOSITIDAE.

(*Cadelles*).

Ips fasciatus Oliv., shown in Fig. 50, is sometimes very abundant among and beneath heaps of carrots. It is a rather pretty insect, shining black with two bright, interrupted, reddish or orange bands across the elytra. None of these insects are espe-

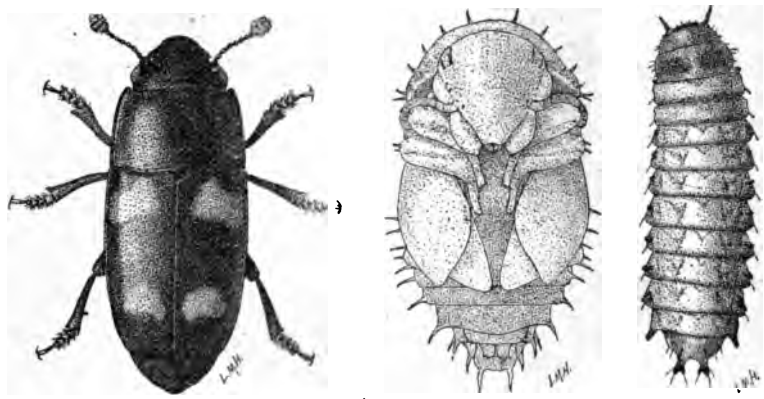


Fig. 50. *Ips fasciatus*, Oliv. After Forbes.

cially injurious. This can not be said about the nearly related species of *Tenebrioides*, frequently called "cadelles." These insects are found in large numbers in barns and mills, where they feed on grain, meal and flour. In mills they can cause great damage, not so much by eating the flour as by eating holes in the fine and expensive bolting silk. One species (*T. mauritanica*, Linn.), is shown in Fig. 51.

Such beetles are sometimes found in most unexpected places. The illustration (Fig. 52) shows the work done by their larvæ in some books stored in a bin. Whether these insects were after knowledge, and studied a Norwegian book or not, is left an open question.

C. SAW-HORNS.

(*Serricornia*).

They contain numerous families of beetles, some of which need description, as many very injurious insects belong to this group.

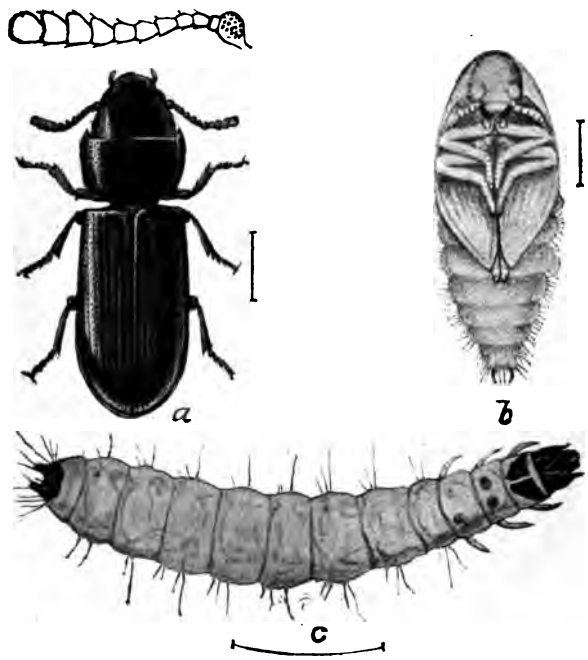


Fig. 51.—*Tenebrioides mauritanica*, Linn. After Division of Entomology, U. S. Department of Agriculture.

Fig. 52.—*Tenebrioides mauritanica*, Linn. as a student. Original.

FAMILY ELATERIDAE.

(*Snapping, Clicking, or Spring-beetles*).

Notwithstanding the large number of beetles that form this family, they are nearly all readily recognized in all of their stages, and every boy knows the acrobatic performances of the adult snapping-beetles. If touched ever so lightly the beetle drops to the ground, usually landing upon its back; after remaining perfectly quiet for a time, as if dead, we hear a sudden click, the beetle pops into the air, and falling upon its short legs, runs away. When we study the under side of the beetle to discover the means which enable it to act in this peculiar fashion, we find that the pro-thorax is loosely jointed to the rest of the body, and that on its under side there is a curved horn which fits into a cavity of the meso-thorax (Fig. 53). When such a beetle is laid

Fig. 53.—Elater ready to snap. After Smith.

on its back it bends in such a way as to bring the tip of the curved horn to the edge of the cavity, and by a sudden release of muscular tension, this tip slips and the insect is thrown into the air.

Most of our snapping-beetles are small, or of medium size, but a few are quite large, sometimes reaching two inches in length. As a general rule they are of a uniform brownish color; some are black or grayish, and still others are gayly colored, even metallic. The very elongated body tapers more or less towards each end, and is sometimes flattened . The feelers are moderately long, more or less serrated, very much so in the males of some rather uncommon species. The outer angles of the very wide pro-thorax are usually prolonged into points, which curve around the edge of the wing-covers.

The larvæ of the click-beetles live in the ground and in decaying wood; they sometimes eat other insects found in similar places. These larvæ have been named "wire-worms," a name that well describes the form and hardness of their bodies. They are long, narrow, worm-like, very even in width, decidedly hard, and of a brownish or yellowish white color. Besides a stumpy projection on the last joint, acting as a sort of prop for the long abdomen, they have only the usual three pairs of jointed legs in front. Nor do they need long legs, as they live well hidden in the ground or in rotten wood. They are mostly vegetable feeders, and there are but few cultivated plants which they do not injure. What makes it worse is the fact that they are so well hidden, and that they cause most injuries at a time when the plants are still young and tender; in fact, even seeds are frequently destroyed before they have germinated. In this way fields of corn and other grain are more or less frequently destroyed by wire-worms, and as we have over 500 species of such noxious beetles in the United States alone, the damage caused by them is not slight. A few of these wire-worms are, however, somewhat beneficial, as they hunt for and eat wood-boring larvæ.

The larva of one of our largest species, the Eyed Elater, (*Alaus oculatus* Linn.), is one of the few which largely subsists upon other insects; at least all the larvæ kept by the writer in decaying wood would soon perish if not provided with living insects, which were soon discovered by these cannibals and devoured. The large, yellowish-brown larva of the *Alaus* transforms to a pupa, and later into a most striking beetle (Fig. 54), black in color, the elytra covered with fine lines and flecks of white scales arranged in ridges. But the most remarkable markings are a pair of large velvety-black spots, encircled with white, upon the pro-thorax, which spots are frequently mistaken for eyes; the true eyes are, of course, situated at the usual place on each side of the head, and are rather small.

Such wire-worms as live in the ground, and which feed upon the roots of plants, sometimes causing great losses to cereals and to other cultivated plants, as the strawberry, are exceedingly dif-

ficult to reach with any material that will kill them. In fact, most of the many remedies which at one time or another were claimed as infallible, have proven to be of very little benefit.

The life-habits of the subterranean species may be stated in general to be as follows: the beetles, which appear very early in spring, and which may be found under loose bark, under stones and boards, or in fields in which the sod has been turned over, fly about late in May or early in June, during the warmer portions of the day. After copulating they deposit their eggs in grass-land, or among weeds, or wherever there is an abundant vegetation of a

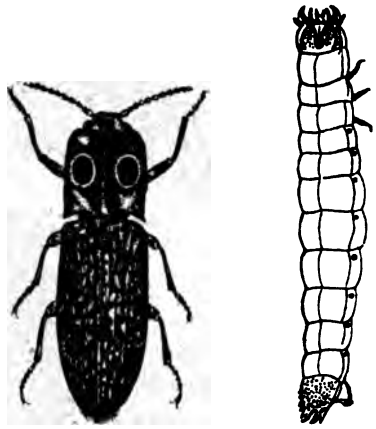


Fig. 54.—*Alaus oculatus*, Linn., and larva. After Harris.

grassy nature. During midsummer the larvæ hatch and feed upon the roots of many plants for two or three years, when they reach their full size. They change to pupæ early in fall, and soon afterwards to adults; these, however, do not leave the ground until the next spring. From this life-history it will appear that we can not directly apply any poison that will kill the larvæ. By attracting adult insects to bait during the spring we may kill a few. The only possible method to get rid of them is good cultivation and proper rotation of crops. Meadows infested should be plowed during the fall, when the full-grown larvæ,

pupæ and adults are killed, at least many of them are. But the younger ones are not, and as they remain in the larval stage for two or three years, the fall plowing should be repeated many times. Professor Smith recommends the use of crimson clover, which should be sown soon after the beetles have laid their eggs, and it should be harvested and plowed under so as to prevent the development of the larvæ. In our fruit gardens the wire-worms can only be destroyed by constant attention.

Some species also feed upon flowers and fruit, but the dam-

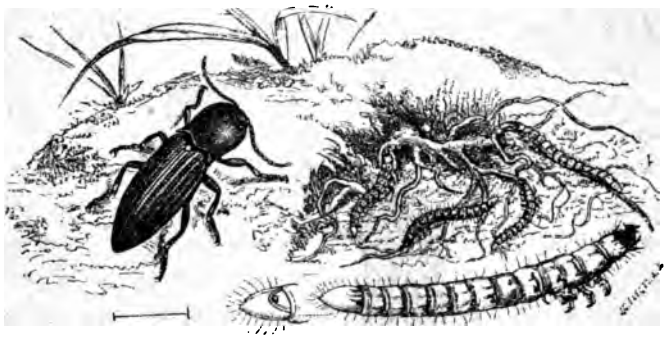


Fig. 55.—Wire worms at work. After Brehm.

age caused by them is slight. Fig. 55 shows a click-beetle with a number of larvæ at work, and Figs. 56, 57 and 58 show the adults of some very injurious species found in Minnesota.

A few members of this family have the pleasant habit of eating the eggs of our destructive locusts, hence are decidedly beneficial. The larvæ of *Cryptohypnus bicolor* Esch., which has this very commendable habit, is shown in Fig. 59.

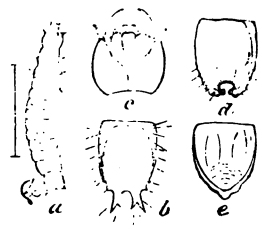


Fig. 59.—*Cryptohpnus bicolor*, Esch., larva. After Riley.

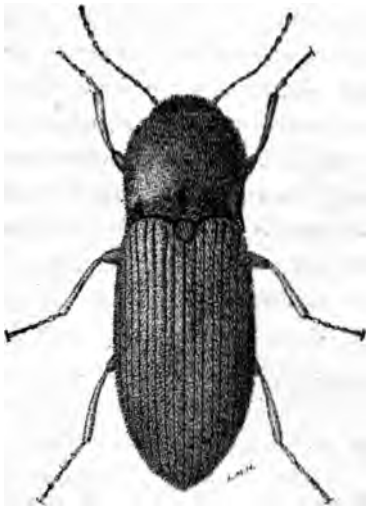


Fig. 56.—*Agriotus mancus*, Say. Greatly enlarged. After Forbes.

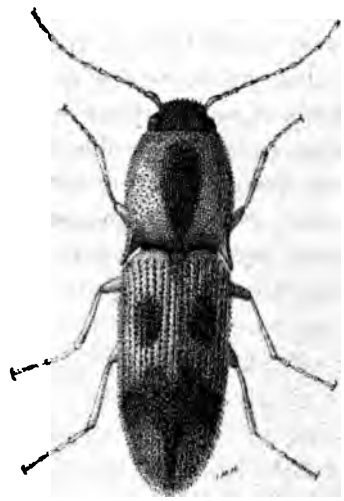


Fig. 57. — *Drasteria elegans*, Fab. Greatly enlarged. After Forbes.

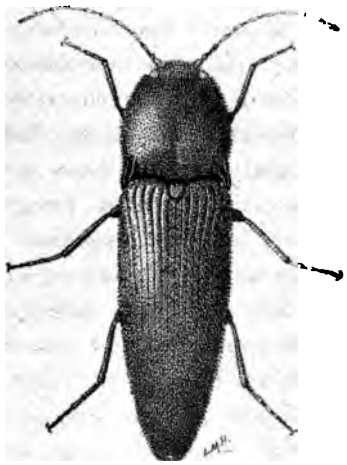


Fig. 58.—*Melanotus communis*, Gyll. Greatly enlarged. After Forbes.

Fig. 60.—*Pyrophorus noctilucus*. Natural size. After Brehm.

In Florida and Texas occur snapping-beetles which are very luminous; others very much larger occur in the tropics, and some of our soldiers have no doubt seen such insects as the one illustrated in Fig. 60, which produces a very strong greenish light.

The writer has kept such luminous beetles for a long time in the hollow joints of sugar canes, much to the delight of visitors. The Cuban ladies make a singular and pleasing use of these living gems by keeping them in little lace pockets upon their dresses, or arrange them as a fillet for their hair. A ballroom with numerous dancers wearing such "flashing" jewels is a very peculiar sight. Fig. 60 shows one of these large beetles; the two whitish spots, one on each side of the pro-thorax, and the posterior part of the under side of the abdomen, are luminous.

FAMILY BUPRESTIDAE.

(*Flat-headed Borers*).

These beetles, also called "*Metallic Wood-Borers,*" and "*Saw-horned Borers,*" resemble the click-beetles in shape, being usually rather long and narrow; their bodies are hard and compact, frequently looking as if cast of bronze. Their feelers are rather short, and serrated on their inner edge; the first and second abdominal segments are soldered together on the ventral side; the head is deeply inserted in the pro-thorax, and the latter broadens but slightly behind, fitting tightly over the base of the wing-covers. The beetles do not possess the power of springing when placed on their backs. The colors found in this family of beetles are richer than those found anywhere else in nature; some species are pale brown or gray with brassy or coppery reflections, others have the entire surface minutely roughened and indented, looking like beaten metal. Still others are blue, green, violet or golden, burnished in spots, or covered with delicate shingle-like scales, seemingly made of polished metal. Such beetles are diurnal insects, flying about during the hottest part of the day, or disporting themselves upon the trunks of trees, running about swiftly, or resting, always exposed, as if proud of their beauty. Some of them are very active, almost as much so as tiger-beetles, and use their wings with great ease; others drop to the ground when disturbed, or feign death, not trying to escape by flight.

Most of the larvæ of these borers live inside the wood of trees, more especially beneath the bark; others are gall-makers, or even leaf-miners. Their larvæ are very peculiar beings, being characterized by an enormous expansion of the first thoracic joint, from which the two posterior joints taper abruptly to the slender and cylindrical abdomen. In other cases all three thoracic joints are more or less expanded, though in some cases they are also normal. On account of this flattened appearance such larvæ are frequently called "flat-headed borers," a name very expressive, though by no means correct, as the head itself is not flattened, but appears as a small appendage upon the anterior edge of the flattened joint or joints. Sometimes they are also called "tad-poles," for self-evident reasons. The larvæ of typical *Buprestidae* possess no legs; but those of the mining species have cylindrical bodies with three pairs of legs. The adult forms of these latter are also much shorter than is usual in this family. "Flat-headed Borers," sometimes named "Hammer-heads," infest not only trees, shrubs and vines, but sometimes even herbaceous plants. Some prefer dying wood, others attack apparently healthy and vigorous plants. The pupa is formed inside the burrow or mine made by the larvæ, and is of the usual form.

Some of the worst pests of fruit-producing plants belong to this family of insects, and the more important will be described and illustrated.

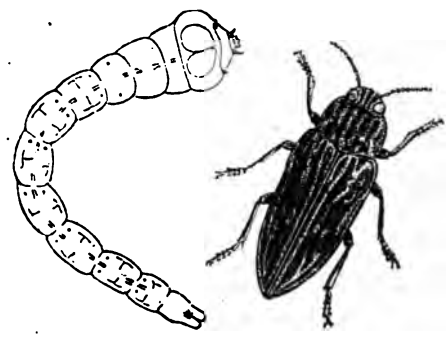


Fig. 61.—*Chalcophora* species. After Brehm

The largest of our common Buprestids is the ***Virginian Buprestid*** (*Chalcophora virginiensis* Drury). It is very abundant wherever pine trees grow in forests. It is a copper-colored insect, with the elytra deeply and irregularly furrowed. The larvæ are very destructive to pines, but are also found in other trees. A similar European species is illustrated in Fig. 61. The genus *Dicerca* contains a number of kinds of a more robust form, which have the elytra so strongly narrowed toward the tips as to appear like tails. The wing-covers are very convex, irregularly marked with elevated spots and ridges, copper-colored or brassy, with greenish reflections. Their larvæ infest a number of trees, among them the peach, plum, cherry, hickory, beach and maple.

THE DIVARICATED BUPRESTIS.

(*Dicerca divaricata* Say).

This beetle is fairly abundant in Minnesota, and is illustrated in Fig. 62; it is from seven to nine-tenths of an inch in

Fig. 62.—*Dicerca divaricata*, Say. After Division of Entomology, U. S. Department of Agriculture.

length, copper-colored, with brassy reflections, and thickly covered with little pits. The thorax is furrowed in the middle; the elytra contain numerous impressed lines, and small, elevated, blackish spots; the tail-like tips of the elytra are blunt, and spread apart a little like a swallow-tailed coat. Such beetles are found, not very often, however, sunning themselves during June, July and August on the trunks and limbs of old cherry and plum

trees; or they are found running up and down the trunks, enjoying the sunshine.

The eggs are deposited in the crevices in the bark of such trees, also in that of the peach. Here they hatch, and the young larvæ eat their way through the bark, and hereafter live in and destroy the sapwood underneath. The larva has the general appearance of a flat-headed borer.

THE FLAT-HEADED APPLE-BORER.

(*Chrysobothris femorata* Fab.).

The members of the large genus *Chrysobothris* are quite flattened above; the wing-covers possess irregular depressions and elevations, and the pro-thorax has curved sides and is narrowed behind. The species under discussion is well illustrated in Fig. 63. It measures from three-eighths to half an inch or more in

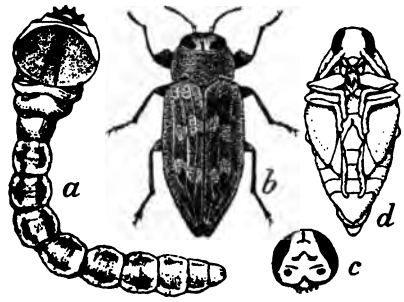


Fig. 63.—*Chrysobothris femorata*, Fab. Enlarged. After Division of Entomology, U. S. Department of Agriculture.

length, is of a flattish, oblong form, shines greenish-black, and has three raised lines on each of the wing-covers, the outer two interrupted by two impressed transverse spots of a brassy color, which divide each wing-cover into three almost equal portions. The under side of the body and the legs are of burnished copper, the feelers are green. The insect varies greatly in size, and there are a number of variations found in the United States, some being very much brighter in colors than others. The name, "flat-headed apple-tree borer,"

is somewhat misleading, as this insect is by no means confined to the apple, but injures a great variety of orchard and forest trees. It is one of the most injurious of all buprestids. Professor Saunders, in his book, "Insects Injurious to Fruits," a book that ought to be in the hands of every fruit-grower, gives the following life-history of this pest:

"This pest is common almost everywhere, affecting alike the frosty regions of the North, the great West, and the sunny South. It is much more abundant than the two-striped borer, and is a most formidable enemy to apple-culture. It attacks also the pear, the plum, and sometimes the peach. In the Southwestern States it begins to appear during the latter part of May, and is found during most of the summer months; in the Northern States and in Canada its time of appearance is June and July. It does not confine its attacks to the base of the tree, but affects the trunk more or less throughout, and sometimes the larger branches.

"The eggs, which are yellow and irregularly ribbed, are very small, about one-fiftieth of an inch long, of an ovoidal form, flattened at one end, and are fastened by the female with a glutinous substance, usually under the loose scales or within the cracks and crevices of the bark; sometimes singly, at other times several in a group. The young larva soon hatches, and, having eaten its way through the bark, feeds on the sap-wood within, where, boring broad and flattish channels, a single specimen will sometimes girdle a tree. As the larva reaches maturity it usually bores into the more solid wood, working upward, and, when about to change to a pupa, cuts a passage back again to the outside, eating nearly, but not quite through the bark. Within its retreat it changes to a pupa, which is at first white, but gradually approaches the color of the future beetle, and in about three weeks the perfect insect emerges, and, having eaten through the thin covering of bark, escapes and roams at large to continue the work of destruction.

"The mature larva is a pale-yellow, legless grub, with its anterior end enormously enlarged, round, and flattened. At *A*,

in figure 63 the upper side of the anterior swollen portion of the body is shown. Whether this larva requires one or two seasons to reach maturity has not yet been determined with certainty, but the opinion prevails that its transformations have been completed in a single year.

"*Remedies.*—One might reasonably suppose that this larva, in its snug retreat, would be safe from the attack of outside foes; but it is hunted and devoured by wood-peckers, and also destroyed by insect parasites. A very small fly, a species of Chalcid, destroys many of the larvæ; besides two larger parasites have been bred from them, one of which, *Bracon charus* Riley, is rep-

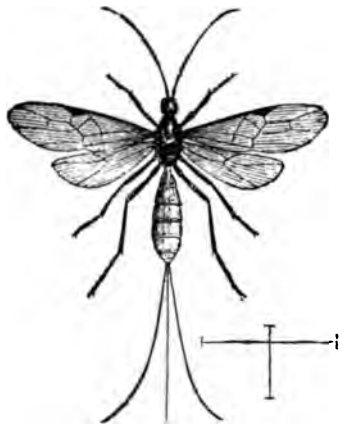


Fig. 64.—*Bracon charus*, Riley. After Riley.

resented magnified in Fig. 64, the hair-lines at the side showing its natural size. The other species, *Cryptus grallator* Say, is somewhat larger; they both belong to that very useful group of four-winged flies known as Ichneumons.

"Although healthy, well-established trees are not exempt from the attack of this enemy, it is found that sickly trees, or trees newly transplanted are more liable to suffer, especially on the southwest side, where the bark is often first injured by exposure to the sun, resulting in what is called sun-scald. All trees should be carefully examined early in the fall, when the young

larvæ, if present, may often be detected by the discoloration of the bark, which sometimes has a flattened and dried appearance, or by a slight exudation of the sap, or by the presence of the sawdust-like castings. Whenever such indications are seen, the parts should at once be cut into with a knife and the intruder destroyed. As a preventive measure there is perhaps nothing better than coating the bark of the trunk and larger branches with a mixture of soft soap and a solution of soda."

Professor John B. Smith, in his valuable book, "Economic Entomology," in speaking of remedies against this or similar borers, says:

"In general we are very helpless against boring larvæ once they get into the trunk of a tree. Cutting out is a tedious process, even if the location of the larva is easily discoverable, which it often is not. We must, therefore, try to prevent their entrance, and this may be done more or less completely by mechanical means. As against the larger species—i. e., against all except *Agrilus*—a wire mosquito netting loosely encircling the trunk, so as not to touch it anywhere, is a complete protection. The insects lay their eggs under a bark scale, or on smooth bark gnaw a little hole in which the egg is laid, and if access to the bark is prevented, they seek other localities. The wire must be tied at the top to prevent beetles from getting under it, and must extend under ground an inch or so. In this way we not only prevent new infestation, but any beetles that may emerge from the trunk will be hopelessly imprisoned, and will die without a chance to reproduce.

"Instead of wire-netting, tarred paper or even newspapers tightly wrapped around the trunk and branches will answer an excellent purpose, needing renewal each year, however, where the wire-netting lasts several seasons. Thorough white-washing offers a large measure of protection,since the adults will not voluntarily eat through a coat of it, and the larvæ can not do so when first they emerge from the egg. The whitewash can be applied with a knapsack pump through a Vermoral nozzle, and a little Paris-green adds greatly to its effectiveness. It should be renewed

every week or so till the middle of July, when the danger from these flat-headed borers may be considered at an end; and it has the advantage of protecting the branches as well as the trunk. The admixture of a little glue or salt will improve its adhesive and lasting qualities.

"A strong fish-oil soap, say one pound in one gallon of water, is also effective, and may be applied in the same manner. It forms a film of soap over the bark, and is repellent to the beetles as well as fatal to the young larvæ. The admixture of an ounce of crude carbolic acid to a gallon of suds is advantageous. This mixture should not be applied to leaves or on young shoots, as it would probably cause injury. As these remedies are all preventive rather than curative, they must be promptly and thoroughly applied, and success will be in proportion to the thoroughness with which the work is done. Instead of any of the preceding methods, "insect lime," or "dendrolene," may, with proper precautions, be employed on the trunks and larger branches, and, practically, this is the best material for use against the "sinuate pear-borer." It can be easily applied, remains effective for weeks, and one application, properly made at the right time, will protect the trees for the season. As against the pear-borer, it should be applied not later than May 15th, and kept intact until June 15th, when all danger from that pest is over."

Among the smaller species of beetles of this family are some that are very destructive, and it seems that more and more of them become so where the country is more densely settled, and where the native forests give place to cultivated fruit-trees. Still other species find their way to this country with imported trees and plants; and they soon become more destructive here than in their native home, very likely because their insect-enemies do not follow them at the same time.

The genus *Agrilus* contains a large number of species, which differ from those mentioned before by their slender, cylindrical form, with a squarely truncate head, seemingly cut off in front, and with elytra much narrower at the tips.

THE RED-NECKED BLACKBERRY-BORER.

(*Agrilus ruficollis* Fab.).

This very common beetle, much more common in Minnesota than most people would believe, is found wherever blackberries and raspberries occur. In the burned over regions about Hinckley, where a dense growth of these plants has covered the ground since the fire, the writer has seen small plants of raspberries upon the leaves of which he could count, not dozens, but hundreds of these pretty insects disporting themselves in the bright sunlight. They are very active, flying away when disturbed, or, dropping to the ground as if dead, are difficult to discover among the dead material found under such plants. Of course wherever they are found in such numbers they must be injurious.

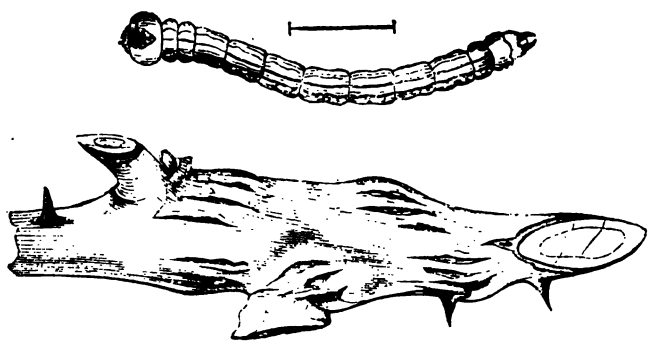


Fig. 65.—*Agrilus ruficollis*, Fab. Gall and larva. After Riley.

Sometimes the presence of their larvæ can be readily detected by the swollen appearance of the vines (Fig. 65), which look gouty, hence the name Raspberry Gouty-gall. This swelling is caused by the constant irritation caused by the larva inside. The swollen portions of the cane are not smooth, but have the surface roughened with numerous slits and ridges. When we cut under such ridges we find a burrow under each of them, and in it, or in the soft adjoining substance, we find the culprit. It

is a peculiar worm, with an almost thread-like, pale-yellowish or white body, with the anterior segment enlarged and flattened. The small head is brown, the powerful jaws are black, and the tail is armed with two slender dark-brown horns, each with three blunt teeth on the inner edge. When this worm is mature it measures about six-tenths of an inch in length. But not all the worms form such galls; many can be detected in canes not showing any swellings.

While still young the larvæ inhabit mainly the sap-wood, and following an irregular spiral course, they frequently girdle and destroy the cane. In most cases a number of worms are found in a single cane. Early in May the full-grown larva enters deeply into the pith of the cane, and here it changes to a pupa, from which the adult escapes soon afterwards.

The eggs are deposited early in summer, mostly during the month of July; they are laid on the young canes.

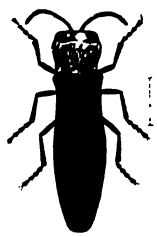


Fig. 66.—*Agrilus ruficollis*, Fab. After Riley.

The beetle is a rather beautiful insect with velvety brownish-black wing-covers, a rather small, dark, bronzy head, and a very bright coppery neck or pro-thorax; the underside is of a uniform shining black color; it measures about three-tenths of an inch in length, and is shown in Fig. 66.

Prof. Smith, who has closely studied the life-history of this beetle, writes that "it is good practice to cut out all galled canes early in spring, and *burn them*. Trimming is done at this time as a matter of regular cultivation, and the galls are then easily seen.

No "galled" cane ever ripens a fair set of berries, and it might as well be cut out at once. Another satisfactory method is to cut off all the new shoots at the surface of the ground about the end of June. At this time all the beetles have laid their eggs,

Fig. 67.—*Agrilus* sinuatus. After Division of Entomology, U. S. Department of Agriculture.

and the shoots which come up in July can not be infested. (Of course in our state we should wait at least fourteen days longer with this operation). The best results will be obtained by combining both methods. Cutting the new shoots causes the death of the young larvæ, which are unable to subsist on dead wood, and being footless, they are unable to migrate to new stalks."

Another species of *Agrilus* (*A. sinuatus*), imported from Europe within recent years, is very destructive in the eastern United States; its larva feeds between the bark and wood of pear-trees, making immensely long zig-zag galleries, and in this manner girdling and killing the tree. It differs in one remarkable respect from our destructive species in that it remains two years in the larval state. Although not found in Minnesota, the peculiar work of this injurious insect is illustrated (Fig. 67), so that it may be recognized in case our orchards should ever abound

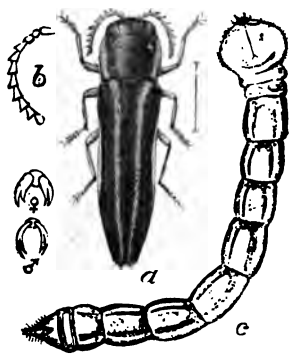


Fig. 68.—*Agrilus bilineatus*, Web. After Division of Entomology, U. S. Department of Agriculture.

in such luscious fruit as pears. Fig. 68 illustrates still another species (*A. bilineatus* Webb), which is not rarely found in Minnesota.

After describing such destructive beetles as those mentioned above, it is a pleasure to be able to say a good word for the insects that form the next families.

FAMILY LAMPYRIDAE.

(*Fire-flies and Soldier-beetles*).

It is scarcely necessary to describe fire-flies, as they are so well known, at least in their adult or winged state. Children living in the country have seen these beautiful objects flying over low places, such as marshes and wet meadows, or have observed them in the bushes growing along streams, ponds or lakes; they have seen the flashes produced by them along the borders of forests, or in the orchards nearer by. But children in the large cities have no opportunity to admire such wonderful phenomena, excepting, perhaps, in the larger parks. The flashes of light are given off at regular intervals, both during flight and when at rest in the grass. In some cases both male and female insects are luminous; in others it is only the one sex, and in still other instances, as in the so-called "glow-worm," the female is wingless.

When we look more carefully at these nocturnal beetles, we find that the terminal segments of the abdomen are of a bright sulphur-yellow color on the under side, which, at the will of the insects, glow with a phosphorescent light of considerable power. Different species have such luminous spots arranged in various ways, and some lack them altogether. The beetles are of a soft texture, usually slender, somewhat flattened above,

Fig. 69.—Fire Flies. After Brehm.

with a more or less retracted head. The prothorax is expanded in a thin projecting margin, which in some cases almost entirely covers the head. The peculiar power of emitting light serves two useful purposes: it is no doubt a great protection to the beetles, and it brings together the sexes. As a protection it only fails in the case of bull-frogs, which gobble up such insects in spite of the fire, which is, however, of a cold nature. In fact such frogs can be readily attracted and caught by using fire-flies as a bait. The larvæ of fire-flies burrow in the earth, and some of them are slightly luminous; they feed upon the soft bodies of other insects, upon snails, and upon other similar food. A number of such insects are illustrated in Fig. 69.

Other members of this family of beetles, which are diurnal in their habits, are called "Soldier-beetles" (Fig. 70). They are

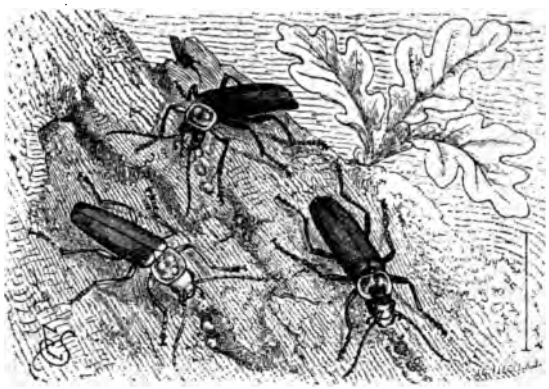


Fig. 70.—Soldier-Beetles.—After Brehm.

also soft, and frequently quite gayly colored. They are found upon flowers, where they feed upon pollen or nectar, being enabled to do so by the possession of a fleshy filament attached to each maxilla. Both fire-flies and soldier-beetles eat insects, sometimes even very large ones. The writer has in his possession a common Lightning Bug, (*Photinus pyralis* Linn.), which was found in the act of eating a beetle of equal bulk. But the bene-

fit to owners of fruit-producing plants is derived from the food-habits of the larvæ of such insects. The larvæ of the "*Two-lined Soldier-beetle* (*Telephorus bilineatus* Say), are very common, and may be seen late in fall running over sidewalks, evidently in search of winter quarters. These small, very dark brown and velvety beings, narrowed at each end, with the edges

Fig. 71.—*Telephorus bilineatus*, Say. After Riley.

of the segments quite prominently marked, are very beneficial in our orchards, and devour immense numbers of such destructive beings as the larvæ of the plum-curculios, when these enter the ground to pupate. The fat worms of the codling-moths are also to their taste; in fact they are very ravenous, and destroy many noxious insects. The larva of this insect is shown in Fig. 71.

FAMILY CLERIDAE.

(*Checkered-beetles*).

A large number of beetles are included in this family. Most of them are carnivorous, but a few eat dried skins, decaying meat and similar substances. The adults are found on flowers and on the trunks of trees, running about rapidly, somewhat resembling brightly colored ants (Figs. 72 and 73). Some, if

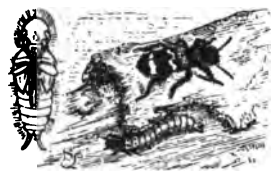


Fig. 72.—*Clerus spec.* After Brehm.

Fig. 73.—*Trichodes spec.* After Brehm.

not most of them, are beautifully marked with strongly contrasting colors, for which reason Prof. Comstock calls them "Checkered Beetles" in his valuable book entitled "Manual for the Study of Insects." Some are decidedly ant-like, the prothorax in this case being narrower than the wing-covers, and slightly narrower than the head. These insects have rather long legs, the antennæ are almost knob-like; their bodies are more or less cylindrical, with a firm texture. Many species are quite hairy, others almost smooth.

The larvæ are usually carnivorous, and are most frequently found in the burrows of wood-boring insects, chiefly in those that live in sap-wood; others are found in the nests of bees, and still others feed on dead animal matter. The slender larvæ possess short legs and a somewhat prominent and pointed head. They are extremely useful in keeping in check such destructive

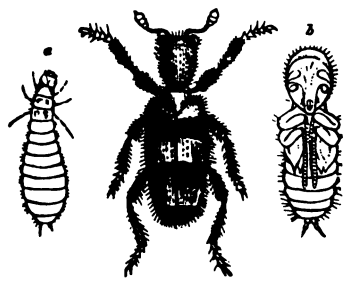


Fig. 74.—*Trichodes apivorus*, Germ.; *a*, larva; *b*, pupa. All enlarged. After Riley.

beetles as bark-beetles and other borers, and for this reason deserve our consideration. Another species of these beetles is shown in Fig. 74; it is an insect that can not be called beneficial, as it is found as larva in nests of bees, where it feeds upon their young, upon honey, and stored pollen. It is not very common in Minnesota, and is easily recognized by the brilliant red-banded wing-covers.

Some of these beetles are exceedingly numerous in the pine regions of our state, where they do much good by eating the numerous bark-insects so destructive to evergreen trees.

Another well-known beetle belongs here. It is frequently called the *"Red-legged Ham-beetle,"* (*Necrobia rufipes* Fab.). This cosmopolitan insect is steel blue, with red legs, and is clothed with fine hair. Its normal food is dead animal matter, for which reason they are exceedingly numerous about glue-factories and slaughter-houses. If they confined their attention strictly to such things, they could be called useful, notwithstand-

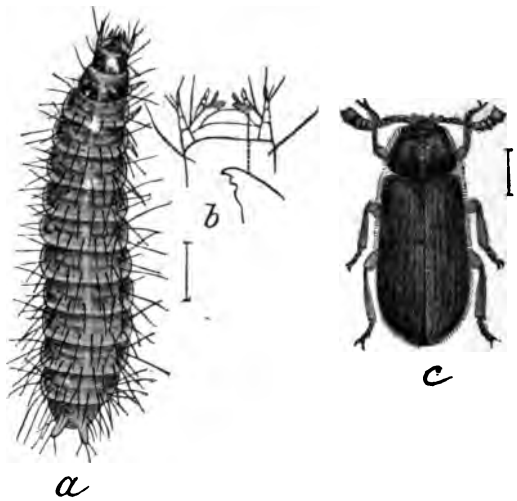


Fig. 75.—*Necrobia rufipes*, Fab.; *a*, larva; *b*, head of same; *c*, beetle. Enlarged. After Division of Entomology, U. S. Department of Agriculture.

ing what the owners of glue-factories might say, but these beetles have learned from experience that smoked ham is much more palatable, and for the reason of obtaining this food they enter smoke-houses and pantries. The illustration, (Fig. 75), gives the two stages of this insect, which sometimes causes considerable losses, not so much on account of what it eats as of what it spoils.

FAMILY MALACHIIDAE.

The beetles composing this family are all small, some very small; they resemble lightning-beetles in having soft bodies and leathery wing-covers, but are very much shorter and broader,

especially towards the end of the elytra, where the abdomen is very broad. The antennæ are also short, a little enlarged at the tip, and in many species the males have them curiously knotted. Upon the sides of their body they possess soft and orange-colored organs, which become plainly visible if the beetles are taken up with the fingers, as in such a case these vesicles are said to exhale strong odors, offensive to cannibal insects, hence they may be considered as organs of defense.

Members of this family are frequently seen in the flowers of

Fig. 76.—*Malachius marginicollis*. Greatly enlarged. After Smith.

fruit-producing plants; they feed also on other insects and their eggs. Others have been found in the burrows made by bark-beetles. To show how such beetles look an illustration of a *Malachius* is given in Fig. 76.

FAMILY PTINIDAE.

(*Death-watch; Cigarette-beetles*).

This family is composed of rather small insects, rarely exceeding a quarter of an inch in length; the family as such is not easily defined, as it contains an aggregation of very odd-looking forms. As a rather general character they have a more or less cylindrical, firm body, solid wing-covers, and a head that can be retracted. Some are possum-like in their method of mimicking death, and they do this so thoroughly well that it is almost

impossible to make them move again. In many cases both legs and feelers fit in grooves, and the entire insect appears to be destitute of such useful organs. As various as are the forms of such beetles, just so various are their food-habits. Yet the majority of the adults and larvæ feed on dried animal or vegetable matter. Some, however, attack green vegetation. Prof. Comstock has bred large numbers of one species from the covers of an old book, a copy of Dante's Divine Comedy, printed in 1536. He does not state whether the insects also consumed the text as greedily as the covers! A description of some of these beetles will show the range of their habits.

THE DEATH-WATCH (*Sitodrepa panicea* Linn.), named so from the ticking frequently made when it is working in wood,

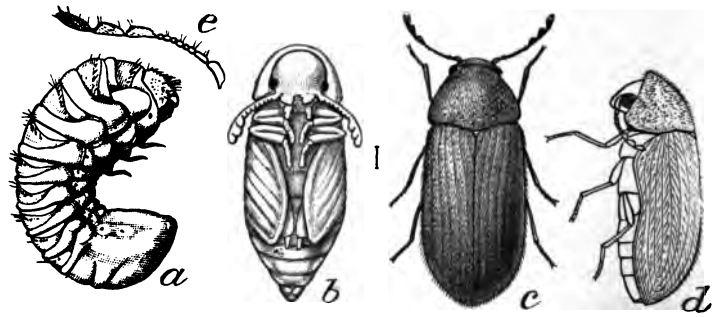


Fig. 76½.—*Sitodrepa panicea*, Linn. After Divislon of Entomology, U. S. Department of Agriculture.

which becomes quite audible during the night when other sounds have ceased, has given rise to many superstitions, and ignorant people consider it as a warning of approaching death. The illustration (Fig. 76½), shows this terrible being to be rather small, and certainly not very alarming. It is a bad insect, however, in other ways; and our soldiers can tell many a story of ship-biscuits enlivened by the presence of their larvæ. In fact the writer has seen biscuits thus infested that contained as much animal as vegetable matter.

THE CIGARETTE-BEETLE (*Lasioderma serricorne* Fab.), is a great lover of the weed in all its forms, and neither chewing nor

smoking tobacco is left undisturbed if it can not have cigars or cigarettes. It is very destructive to all kinds of tobacco, and is a serious trouble to the manufacturers of such ware. Still, even if more cigarettes were spoiled the general loss to sensible peo-

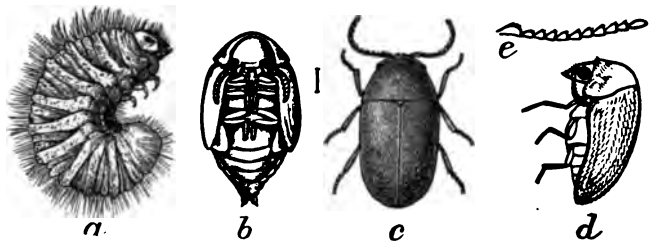


Fig. 76½.—*Lasioderma serricorne*, Fab. After Division of Entomology, U. S. Department of Entomology.

ple would not be very important. But there are other members of this family that deserve the close attention of fruit-growers. The cigarette-beetle is illustrated in Fig. 76½.

THE APPLE-TWIG BORER

(*Amphicerus bicaudatus* Say).

This beetle is cylindrical, about one-third of an inch in length, of a dark chestnut-brown color above and black beneath. By consulting the illustration, (Fig. 77), it will be seen that its thorax is roughened in front with minute elevated points, and in the males is furnished with two little horns; this sex has also two small thorn-like projections at the extremities of the wing-covers. This beetle bores into small apple-twigs in early spring, entering close to a bud, and making a channel several inches in length, apparently to obtain both food and shelter; sometimes the canes of grapes are invaded in similar places, and are killed in consequence. Twigs of pears and cherries are also used for this purpose.

Both sexes make such tunnels, and they are occasionally found in them during the middle of winter as well as in summer; they are usually found in the tunnels with the head downwards. In this manner they sometimes work during the sum-

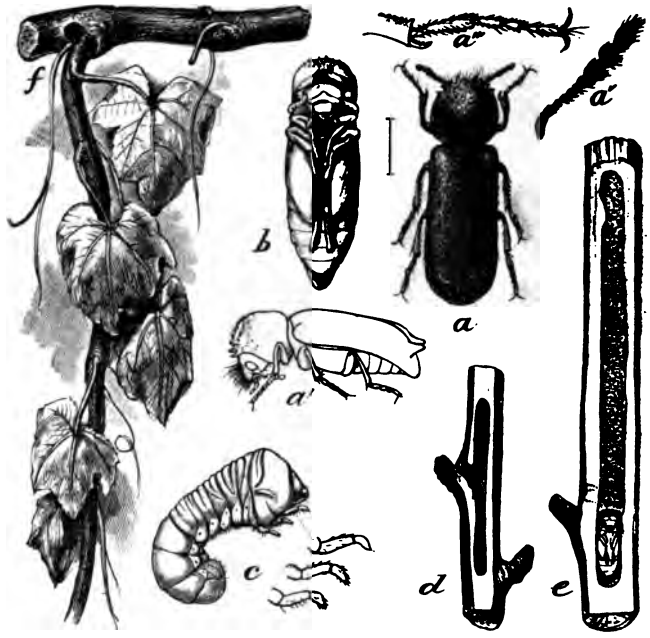


Fig. 77.—*Amphicerus bicaudatus*, Say. After Division of Entomology. U. S. Department of Agriculture.

mer months, and cause the invaded twigs to die; as a general rule, however, the beetles leave their burrows during the summer. They now deposit their eggs in the dead or dying roots of the "greenbrier" (*Smilax* spec.), or in the dead shoots of the grape.

The larvæ, well illustrated in the figure, as well as the pupæ, remain in such places until the full-fledged beetle is formed. The insects are not common enough to cause serious damage. Twigs containing their burrows should be promptly removed and burned, and no greenbriers, a bad weed at the best, should be permitted to grow near orchards. Wild grape-vines, if harboring such beetles in larger numbers, should also be removed.

THE RED-SHOULDERED SINOXYLON.

(*Sinoxylon basilare* Say).

This beetle, closely related to the one just mentioned, is found in our state, but is rather uncommon. It is about one-

fifth of an inch long, black, with a large reddish spot at the base of each wing-cover, as indicated in the illustration (Fig. 78). The thorax is also furnished with elevated points and short spines in front; the wing-covers are roughened with dots, and appear to be cut off obliquely behind; the outer edge of this declivity is furnished with three teeth on each side.

The larva bores into the stems of grape-vines, and sometimes into the twigs of apple and peach. It is a much wrinkled grub, yellowish-white, with swollen anterior segments, three pairs of short legs, a small head, and an arched body. The pupa is formed inside the burrow, and is of a pale-yellowish color.

The only remedy is to remove and burn infested canes and

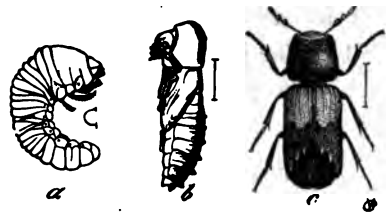


Fig. 78.—*Sinoxylon basilare* Say. After Riley.

twigs. Several other related beetles have been reported as being injurious to orchards, but none of them are found in our state. Others, which do not cause any injury to the plants themselves, but to the posts to which the canes of raspberries, grapes, and other plants are tied, might be mentioned, as fruit-growers are sometimes molested by them.

Beetles belonging to the genera of *Bostrychus* and *Lyctus* destroy old and dry wood. The latter especially are sometimes very abundant, and their presence may be recognized by the large amount of exceedingly fine dust that gathers at the base of such posts.

The beetles themselves are very seldom seen in large numbers on the infested posts, but if we cut open one of them apparently still solid, we find it entirely honey-combed inside. Even such exceedingly dry and hard substances as hoe-handles made

of hickory, if left undisturbed for a long time in warehouses, have been known to be entirely destroyed by insects of this character.

D. LEAF-HORNS.

(*Lamellicornia*).

Leaf-horns contain only two families of beetles; the first one numbers but a few species of remarkable forms, the other a very large number; some of them are scavengers, others plant-feeders. This second family is one of great extent, and many large and showy insects belong to it. But, notwithstanding their different forms and food habits, all resemble each other in the possession of feelers which terminate in a knob composed of three or more leaf-like blades, which, at the will of the insect, can be folded up like the pages of a book.

FAMILY LUCANIDAE.

(*Stag, or Pinching-beetles*).

Stag-beetles are well named on account of certain species, the males of which have immensely large mandibles, sometimes branched like the antlers of a stag. Their chief characteristic, however, is the form of their antennæ. These are tooth-horned, i. e., the tips of the feelers are furnished with several stiff projections on one side, like the teeth of a comb; the feelers are also bent and elbowed in the middle. These projecting plates composing the club can not be closed together as they can in the next family. (Compare Fig. 9).

The adult beetles feed upon the sap of bruised trees, and they can secure this food by means of brushes located upon jaws and lips. By knowing this food-habit many can be attracted by purposely bruising such plants, as young oaks, and even willows. The eggs are large, globular, white objects, which are deposited in the crevices of the bark near the roots. The larvæ

Fig. 79.—*Lucanus elaphus*, Fab. After Fuchs.

resemble "white grubs," only they do not eat the roots of plants, but bore into the solid wood of the trunks and roots of trees, reducing it to coarse sawdust. In most cases the larva requires a number of years to reach its full size.

Stag-beetles are of but little economic importance, but as their forms are very striking, they are of much popular interest. The illustration, Fig. 79, shows the male of the large stag-beetle (*Lucanus elaphus* Fab.), which does not seem to be found in Minnesota, and Fig. 80 that of (*L. dama*, Thumb.), which is fairly common in our state.

THE STAG-BEETLE.

(*Lucanus dama* Thunb.).

The male of this large beetle has the upper jaws or mandibles largely developed; they are curved like a sickle, and possess a small tooth near the middle of the inner margin; the female has smaller jaws, also toothed. Large specimens measure about two

inches in length; they are of a deep mahogany-brown color, the legs being very much lighter. The broad head of the male is smooth, that of the female narrower and rough. The males fly during the months of July and August, and are very strong flyers, so that they can be heard buzzing about during the evening or night. They are attracted by light, and enter our houses, where they greatly scare some persons. They never bite, however, unless forced to do so by being roughly handled. The females are more retiring in their habits, and are not often found, and if seen at all, it is usually upon the trunk of some bleeding tree.

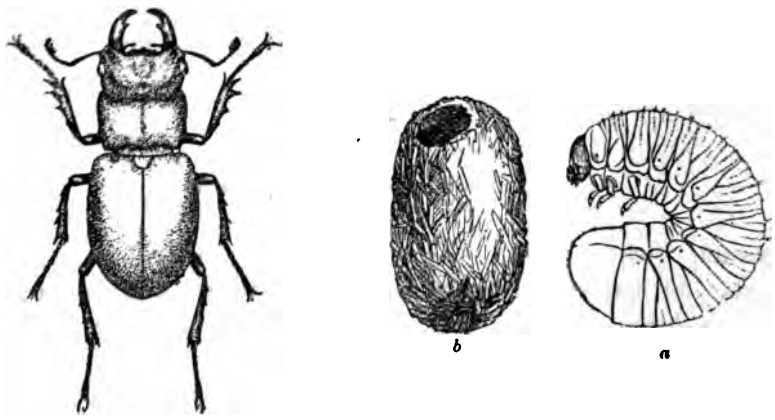


Fig. 80.—*Lucanus dama*, Thunb. Adult; *a*, larva; *b*, cocoon. After Fuchs and Harris.

The large larva of this beetle is found in the decaying wood of many different kinds of trees, such as oak, apple, cherry, or willow. From the very fact that these larvæ are only found in old and decaying trees we can feel certain that they cause but slight, if any damage. Larva and cocoon are shown in Fig. 80.

A smaller beetle belonging to this family, the *Platycerus quercus* Web., is sometimes injurious, because it devours the buds of pear trees. It is also found in Minnesota, but mostly in the decaying wood of old oak logs and stumps. It is a rather peculiar beetle, nearly half an inch in length, with very large jaws in the

male sex, but only small ones in that of the female; it has ribbed wing-covers, black, with a greenish cast. In Illinois it matures about the time at which buds of pear trees unfold, and in such buds the adult beetle feeds for many days, completely eating out the buds and the ends of the new shoots.

FAMILY SCARABAEIDAE.

(*Lamellicorn-beetles*).

This is a very large family, including beetles with a very wide range of variation in size, form, and habits. Most of them are short, stout beetles like the Tumble-bug or June-bug. All possess an antennal club, the leaves of which can be closed together or spread out at will, like a fan, exposing the numerous sensory pits with which they are densely covered.

We can divide the family into two well-marked groups, the *Scavengers* and the *Leaf-chafers*.

The *Scavengers* are of little interest to fruit-growers, but a few forms will be described to give an idea of their form and habits.

The Tumble-bugs are perhaps best known on account of their peculiar habit of forming round balls of dung, which they roll long distances. The two sexes most frequently work together, and after having rounded and compressed the ball by rolling it in dusty places, till it is hard and compact, thus preventing

Fig. 82.—*Ateuchus sacer*. After Brehm.

rapid drying of the enclosed moist material, they finally bury it in the ground. The male now leaves, and the female eats out a cavity in the ball, in which she deposits an enormously large and soft egg; this done, she again closes the cavity by plastering the removed portion of the dung over it. The egg soon hatches, and in a very short time the larva is fully grown, and transforms to a pupa. The whole period of growth takes less than fourteen days. The illustration (Fig. 81, plate 1) shows the ball, egg and adults of one of these beetles (*Canthon laevis* Drury).

Tumble-bugs were well known to the ancient Egyptians, who held one species of them, the *Sacred Beetle* (Fig. 82), in high veneration. They considered it a symbol of strength and resurrection, and for this reason stone imitations of the beetles were placed in the tombs with their dead. "The ball, which the beetles were supposed to roll from sunrise to sunset, represented the earth; the beetle itself personified the sun, because of the sharp projections on its head, which extended out like the rays of light; while the

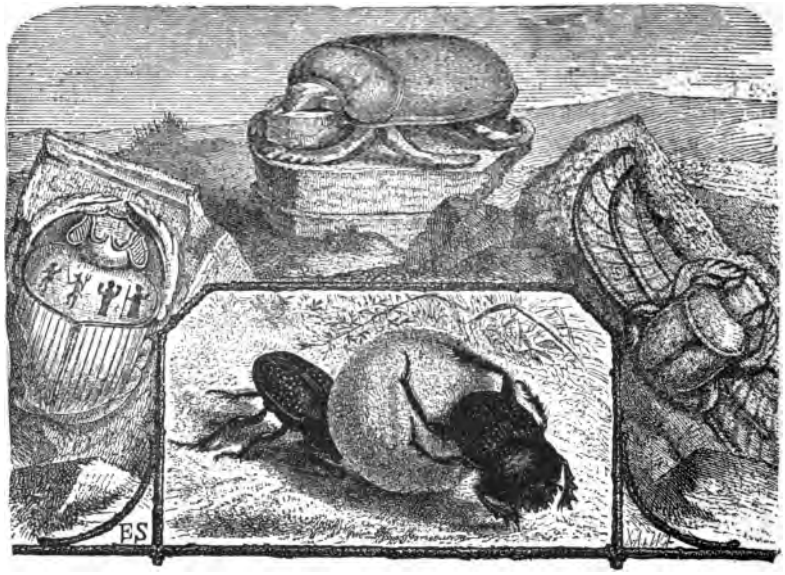


Fig. 83.—*Ateuchus variolosus*. rolling balls. Egyptian sculptures of Sacred beetle. After Brehm.

thirty segments of its six tarsi represented the days of the month. All individuals of this species were thought to be males, and a race of males symbolized a race of warriors. The latter superstition was carried over to Rome, and the Roman warriors wore images of the sacred beetle in rings." The illustration, (Fig 83), shows the familiar action of the two beetles, as well as some scluptures and inscriptions. None of such scavengers are injurious in our country, although exceptions occur in others, where members of scavenger beetles destroy roots of the grape vine.

Other scavenger beetles, like the *Copris carolina* Linn., illustrated in Fig. 84, do not roll balls, but they make holes close to or

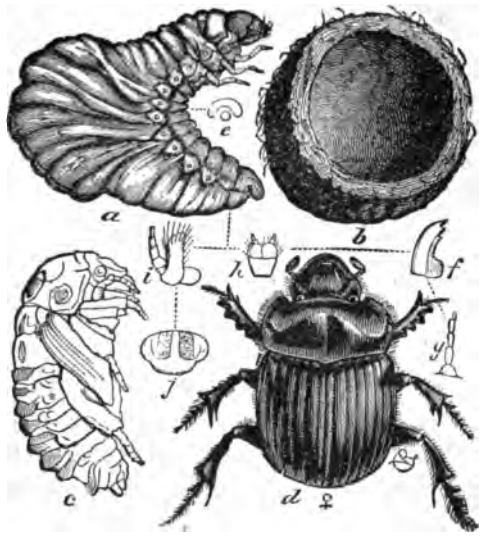


Fig. 84.—*Copris carolina*, Linn.; *a*, larva; *b*, ball; *c*, pupa; *d*, adult female. After Riley.

under manure, especially that of cows, and fill the holes compactly with this substance as a store of food for their larvæ, which hatch from eggs deposited in the lowest parts of such burrows, one in each. Some allied beetles are most beautiful objects, of metallic colors, and beautified in the most remarkable manner with all sorts of odd horns found upon head or thorax.

It has, however, been stated upon very good authority that the common black *Aphodius* (*A. granarius* Linn.), illustrated in Fig. 85, has the bad habit of eating into sprouting seeds of corn. At all events some species of this genus very often attract the attention of farmers, as immense numbers of them swarm early in spring, and again late in autumn, over country roads, and especially over such roads that have been frequented by horses and cows. Here the beetles enjoy their last meals before entering the ground to pass the winter. The illustration (Fig. 86) shows an adult beetle and its larva.

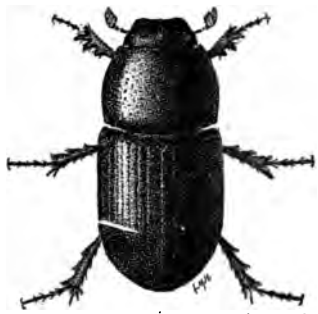


Fig. 85.—*Aphodius granarius*, Linn. Greatly enlarged. After Forbes.

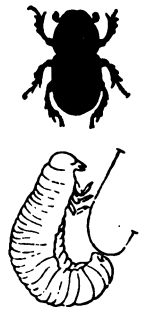


Fig. 86.—*Aphodius fossor*, Linn., and larva. After Brehm.

The *Leaf-chafers*, or *Herbivorous Lamellicorns*, feed upon leaves of trees in their adult state, or they devour the pollen and petals of flowers. They are distinguished from the majority of scavengers by having more slender legs, with long claws which enable them to grasp their food firmly, but do not enable them to dig into the ground. Some of them can, however, do so, but not so easily as their relatives with filthier habits. As a general rule the tip of their abdomen projects beyond the wing-covers, and is not shortened or cut off squarely. Since the adults also feed upon vegetable matter they are in some cases as destructive as their larvæ, only, however, for a much shorter period. The larvæ feed either in rotton wood, when they are harmless, or they eat the roots of grasses and other plants. Such larvæ, well known as "white grubs," are thick, fleshy beings, much wrinkled, with a

body so much curved that they can only crawl about with great difficulty if placed upon the surface of the soil. They possess large horny heads, and long, sprawling legs. The posterior segment of the abdomen is in many species thicker than the remainder, and appears dark, being filled with a large amount of dirt and other waste matter. In their burrows such larvæ can, however, move quite rapidly; they do so by lying on their backs, which are usually protected by a cushion of short hairs; their legs are mainly used to grasp the food overhead.

Many groups of these beetles are familiar, some of them well known by the common name of "May-beetles," "Dor-beetles," "June-bugs," "Rose-beetles," "Goldsmith-beetles," "Rhinoceros-beetles," "Flower-beetles," and others. Only those that are injurious to the fruit-grower, or are otherwise of special interest, will be described more in detail.

We have in Minnesota a number of small lamellicorn beetles that are sometimes destructive to the flowers of fruit-producing plants. They are not numerous enough to cause marked injury, at least not unless many of them are at work on the same tree or cane. They belong to two genera: *Hoplia,* and *Dichelonycha.* The former are robust, oval insects, injurious to apples and plums, of which they destroy the entire flowers. *Hoplia modesta* Hald, an oval shaped, brown beetle, with a metallic white pubescene upon the pointed and projecting posterior segments of the abdomen, and with long legs, well adapted to anchor it in flowers, is the most common one of such small enemies. It measures about one-quarter of an inch in length, and is shown in Fig. 87, Plate I.

Dichelonycha elongata Fab., and *D. subvittata* Lec., also possess a similar bad habit. Both beetles resemble each other in general appearance, but instead of being oval in shape they are quite elongated, measuring almost half an inch in length. Their general color is also brown, but they possess in addition a decidedly metallic lustre, varying from all shades of dark blue to bluish-green or green. In case of necessity these beetles should be gathered and killed. This is easily done upon low plants, where they can readily be seen, but it is almost impossible when

they are found upon trees. But as they are only active during the warmer portions of the day, resting or sleeping at other times in beautiful cradles of white petals, protected by a covering composed of yellow grains of pollen, they are easily shaken into an inverted umbrella, or in extreme cases into a large sheet spread under the tree. However, a simple shaking avails but little, the trees must be jarred by a sharp blow made with a mallet covered with cloth, to prevent injury to the trunks. Both species are shown in Fig. 87, Plate I.

THE ROSE-CHAFER, OR ROSE-BUG.

(*Macrodactylus subspinosus* Fab.).

This destructive beetle is only too well known in some parts of the United States, but happily it is of rare occurrence in Minnesota, at least at the present time. It is found in June, about the time when grapes and roses are in full bloom; it eats such dainty morsels as these highly scented flowers in preference to anything else, but in their absence it is satisfied with leaves.

Prof. Smith, who had ample opportunity in New Jersey to study this beetle, which is illustrated in Fig. 89, writes about it as follows:

"Occasionally, for a number of years, the insects appear in ever increasing abundance, until the swarms are so great that they ruin not only vineyards, but orchards and gardens, eating almost every kind of fruit and flower. In the presence of such swarms we are almost helpless, and insecticides are of no possible use. No contact poison kills them, and the arsenites and other stomach poisons act too slowly, as two or three days suffice to ruin a vineyard. Lest this will seem strange, I will state that I have seen on hundreds of acres of vineyard every vine bearing multitudes, and every bunch of blossoms harbored from two to ten or even more beetles. I have counted over twenty on a single apple, and a full-blown rose may bear as many as thirty or even more. We are reduced to actually collecting the specimens from the vines by means of funnel or umbrella-shaped collectors, adapted

to the method of cultivation in use. They drop readily when the vines are jarred, and the collector should be so made as to roll them into the center and into an attached pail containing kerosene. This must be done not only daily, but continuously for several days until the flight is over or the grapes have set, for well-set grapes are rarely eaten. Fortunately, a period of abnormal increase seems to be followed by a period of decrease, though the length of the periods have not been ascertained. The

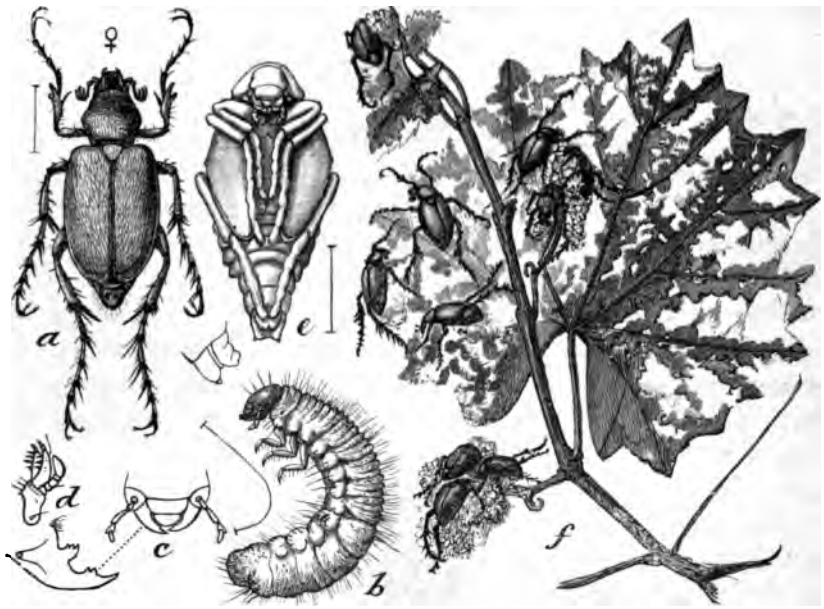


Fig. 89.—*Macrodactylus subspinosus*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

larvæ feed in light land on the roots of various plants, but principally on grass. They pupate in spring, shortly before they change to the adult condition, and by ploughing infested sod at this time a large proportion can be destroyed. When only moderate numbers occur, lime often serves to protect the plants, or, better, the Bordeaux mixture, which is distasteful to them."

As may be seen by the illustration this ochreous yellow

beetle, slender in form, possesses long and very spiny legs, which are so sharp that birds refuse to eat their owners. Even hens will ogle such food, and express their disapproval by letting it severely alone, no doubt having learned from experience that such morsels will not slide down very readily. When stating that the beetle is of an ochreous-yellow color, this statement should be amended by saying that this color is produced by dense and even scales of that color, which rub off very readily, exposing the black colors of the wing-covers and body. In this case we have an insect which is both destructive in its larval and adult stage.

THE SILKEN SERICA.

(*Serica sericea* Ill.).

This small beetle, also oval in shape, but a little larger than the *Hoplia* mentioned before, is of a brown color when still young, but becomes quite dark with age. Specimens not injured by having their surface rubbed are truly beautiful in certain lights, showing in such positions almost all the colors of the spectrum upon a silky background. This is most markedly the case near the sides. But notwithstanding this beauty, they can

Fig. 90. *Serica tricolor*, Say.— After Saunders.

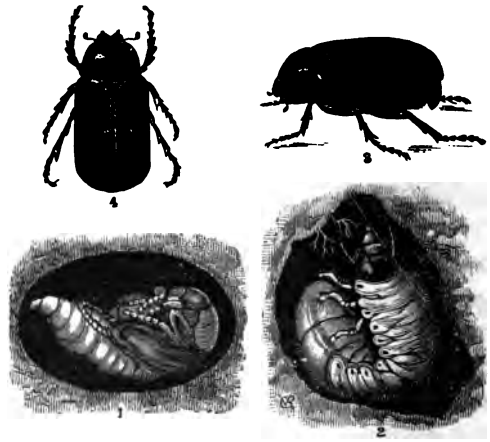


Fig. 91.—*Lachnosterna fusca*, Froehl.—After Division of Entomology, U. S. Department of Agriculture.

become destructive by eating flowers and leaves of our fruit-producing plants. *Serica iricolor* Say is shown in Fig. 90.

This species, as well as two others, the bluish-black *S. iricolor* Say, which has a hairy thorax, and the uniform mahogany-brown *S. vespertina* Gyll., are fairly abundant in Minnesota, and can be kept in check by beating them from the plants into inverted umbrellas, where they can be gathered and destroyed. Their larvæ are not known, but very likely they live upon roots in the ground like the larvæ of related beetles. Other species of this genus are destructive in California. Fig. 87, Plate I, shows *S. iricolor* Say, and *S. vespertina* Gyll.

MAY-BEETLES, OR JUNE-BUGS.

(*Lachnosterna spec.*).

Prof. Saunders, in the book already mentioned, gives a condensed account of the life-history of these beetles in the following words: "Every one must be familiar with the May-beetle,---or May-bug, as it is commonly called,---a buzzing beetle, with a slow but wild and erratic flight, which comes thumping against the windows of lighted rooms in the evenings in May and early June, and, where the windows are open, dashes in without a moment's consideration, bumping against walls, ceiling, and articles of furniture, occasionally dropping to the floor, then suddenly rising again. It sometimes lands uninvited on one's face or neck, or, worse still, on one's head, where its sharp claws become entangled in the hair in a most unpleasant manner. It is a thick-bodied, chestnut-brown or blackish beetle, (Fig. 91), from eight to nine-tenth of an inch in length. Its head and thorax are punctuated with small indentations; the wing-covers, though glossy and shining, are roughened with shallow, indented points, and upon each there are two or three slightly elevated lines running lengthwise. Its legs are tawny yellowish, and the breast is covered with pale-yellowish hairs; the under surface is paler than the upper. During the day the beetles remain in repose, but are active at night, when they congregate upon cherry, plum, and other trees, devouring the leaves, occasionally, when very

Fig. 92.—June beetles at night. After Brehm.

numerous, entirely stripping the trees of foilage (Fig. 92). Their strong jaws are well adapted for cutting their food, and their notched or double claws support them securely on the foliage.

"The female is said to deposit her eggs between the roots of grass, enclosed in a ball of earth; they are white, translucent, and spherical, and about one-twelfth of an inch in diameter. When hatched, the small white grubs begin at once to feed upon the rootlets of plants; they are several years in reaching maturity, and hence larvæ of different sizes are usually found in the ground at the same time. When full-grown, they are almost as thick as a man's little finger; they are soft and white, have a horny head of a brownish color, and six legs; the hinder part of the body is usually curved under, as shown in the illus-

tration. This larva is generally known as the "white grub," and is very injurious to strawberries, devouring the roots and destroying the plants; it feeds also upon the roots of grass and other plants, and when very numerous it so injures pasture-lands and lawns that large portions of the turf can be lifted with the hand and rolled over like a piece of carpet, so completely are the roots devoured. When cold weather approaches, the grub buries itself in the ground deep enough to be beyond the reach of frost, and there remains until the following spring.*

"When ready for its next change, the larva forms a cavity in the ground, by turning itself round and round and pressing the earth until it moulds a cell of suitable form and size, which it lines with a glutinous secretion, so that the cell may better retain its form, and within this it changes at first to a pupa, and finally produces the perfect beetle.

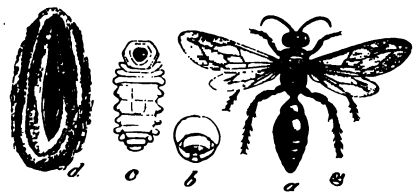


Fig. 93.—*Typhia inornata*, Say. After Riley.

"Remedies:" It is very difficult to reach the larvæ underground with any remedy other than digging for them, and destroying them. Hogs are very fond of them, and, when turned into places where the grubs are abundant, will root up the ground and devour them in immense quantities. They are likewise eaten by domestic fowls and insectivorous birds; crows especially are so partial to them that they will often be seen following the plough, so as to pick out these choice morsels from the freshly-turned furrow. An insect parasite, the unadorned Tiphia, *Tiphia inornata* Say, is also actively engaged in destroying the white grub.

*The writer has long ago come to the conclusion that insects do not enter the ground simply to escape the rigors of winter. If they had to do so, they would be forced in Minnesota to go to the same depth as water pipes, which have to be laid from six to eight feet to prevent freezing!

Frequently, when digging the ground, a pale-brown, egg-shaped cocoon is turned up (Fig. 93*d*); within this, when fresh, will be found a whitish grub, represented at 92*c*, which, during its growth, has fed upon the larva of the May beetle. Within this snug enclosure it soon changes to a pupa, and finally assumes the perfect form, as shown at *a* in the figure. The fly is black, with sometimes a faint bluish tint, with dusky wings, and the body more or less covered with pale-yellow hairs, which are thickest on the under side.

"A curious whitish fungus sometimes attacks this larva and destroys it, growing out at the sides of the head; the protuberance or sprout rapidly increases in size, often attaining a length of three or four inches, when it presents the appearance in Fig. 94. A very large number frequently die from this cause. Trees infested with the beetles should be shaken early in the morning, when the insects will fall, and may be collected on sheets and killed by being thrown into scalding water. Besides the cherry and plum, these insects feed on the Lombardy poplar and the oaks. On account of the length of time the larva takes to mature, the beetles are not often abundant during two successive seasons."

At the time Prof. Saunders wrote the above excellent description the numerous species of the genus *Lachnosterna* were not yet well understood, but since that time a number of entomologists have not alone studied the adult forms, which belong to more than sixty species, but also their larvæ, the "white grubs," have been studied. Hence the description given above applies not to a single species, described as *L. fusca* Froeh., but to a whole group of very similar kinds. Such studies have not, however, given us newer and better methods to combat the injuries caused by such insects in the larval condition; to fight such grubs successfully is still an unsolved problem.

In Minnesota we have a number of species varying in size, color, and structural details; some are small and yellow, covered with long hairs, others are dark and smooth; some fly at the time of year that gives such beetles the popular name of

Fig. 94.—May beetle fungus. After Riley.

Fig. 95.—*Lachnosterna tristis*, Fab.

May or June-beetles, others occur much later in the season, being found as late as the end of September, or even early October. However, none of these later flying beetles are very numerous.

The smallest of our species is the *L. tristis* Fab. (Fig. 95). It is of a light yellowish-brown or ochre-yellow color, densely covered with long and fine hairs; this hair is most prominent upon the thorax, and for this reason the beetle is frequently called the "hairy-necked May-beetle." It is not only the smallest species, but also the earliest to appear, and our oaks suffer very greatly at the time in which the leaves unfold, and it is not an uncommon occurrence to find the tree entirely bare of leaves after repeated nocturnal visits of these beetles. If they are at all numerous the observer can detect their presence by the peculiar sounds produced by them; it seems as though a large swarm of bees was employed in the tree. Such beetles, like many of their larger relatives, are frequently thrown out of the ground early in spring by the spade.

Our most common larger species are the members of the *fusca* group, and the *L. rugosa* Melsh. (Fig. 96), which is distinguished by shining, but at the same time very rugose wing-covers. It is common everywhere, not alone in the wooded regions of the state, but in the open prairies as well.

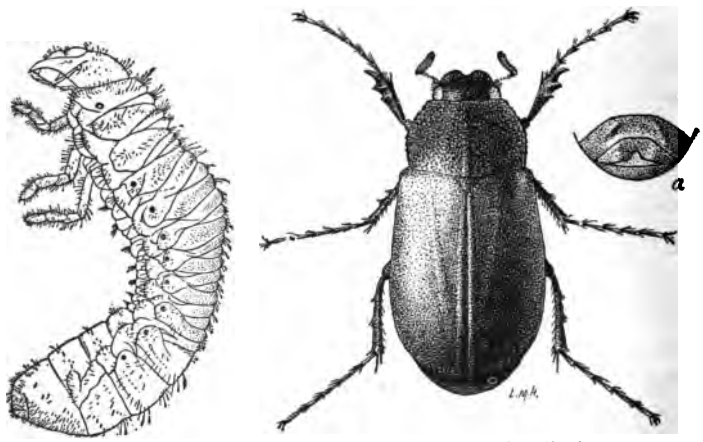


Fig. 96.—*Lachnosterna rugosa*, Melsh. After Forbes.

Other species are covered with a very fine pubescence, almost entirely hiding the wing-covers; others have longer hairs arranged in parallel rows upon the elytra; but all have such a familiar look, that the illustrations given will convey a good idea of the appearance of nearly all.

With us the beetles emerge from the ground just at dusk, or soon afterwards, and they leave the trees long before sunrise, so that the beating of the trees even very early in the morning will secure but a very few, hence does not amount to much as a remedy. But as such insects can be attracted to light, immense

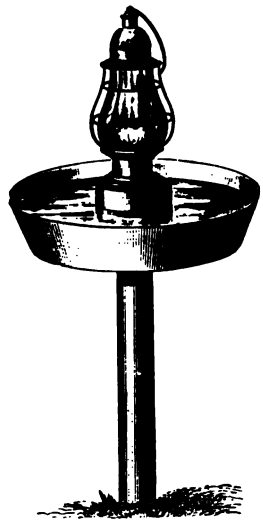


Fig. 97.—Lamp trap. After Lintner.

numbers can be captured and killed by placing under a strong light a vessel containing water with some kerosene floating on it. (Fig. 97). If we study the captured beetles, we find that in some cases only the males of some species have been caught; again we find both sexes in about equal numbers, and in some few cases mainly females are attracted. But whether the females have already deposited their eggs or not is a question, and it is also doubtful whether we do much good by so attracting them. It seems to the writer that the strong light not alone at-

tracts the beetles, but that in doing so we may aggravate the evil in some cases by bringing them to the more valuable trees planted near our houses, in which case the females are certain to deposit their eggs in our lawns.

Among the *Shining Leaf-chafers,* which resemble May-beetles in form, but are separated from them by the possession of tarsal claws of unequal size, one claw in each pair being larger than the other, (see Fig. 99), we find species of brilliant colors

Fig. 98.—*Anomala undulata* Welsh.—Enlarged. After Harris.

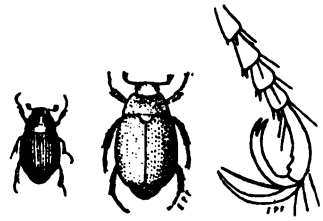


Fig. 99.—*Anomala marginata*, Fab.; *A. lucicola*, Fab., and enlarged tarsal claws. After Lintner.

and markings. This is especially true of tropical species, which contain some of the most beautiful beetles known. They possess wing-covers and bodies apparently made of gold, silver, or other metal. Most of such beetles are also of medium size; others are large, sometimes very large. But few species are found in Minnesota, and none of them are very destructive.

THE LIGHT-LOVING ANOMALA.

(*Anomala lucicola* Fab.).

This beetle feeds upon the leaves of grape and other plants. It is a robust insect, long oval in form, measuring about one-third of an inch in length. It is of a pale yellowish-brown color, the prothorax is either uniform in color, or black, margined with dull yellow; the posterior part of the head and the ventral side of the body are black, but sometimes the abdomen is brown. The beetles vary greatly in color and markings; some are almost

entirely black, and others have two broad diverging longitudinal greenish bands upon the disk of the prothorax. The beetles can be destroyed by means of Paris-green.

A little larger species of this genus is the "Two-spotted Anomala," (*A. binotata* Gyll.), which also varies considerably, but can in most cases be recognized by two larger or smaller, irregular black spots, one upon each wing-cover; head and thorax are uniformly polished black or dark-brown, always much darker than the wing-covers; the under side of the body is colored like head and thorax.

A much smaller species, the *A. minuta* Burm., is quite common in Minnesota. It varies even more than the two species already mentioned, some being entirely dark brown, others bright-yellowish brown; some possess no markings at all, others are ornamented with small spots forming one or more bands across the wing-covers; while still others have numerous dark spots, sometimes confluent, thus forming a narrow upper and broad lower band across the elytra.

Still other members of this genus occur in this state, but are more abundant further south, where they sometimes cause considerable injury to fruit-producing plants. The largest species is *A. marginata,* Fab., a beetle much larger than those already described, measuring about one-half an inch or more in length. It is also brown, but with a peculiar green luster, especially if seen from above. The darker prothorax is edged with a broad margin of yellow. It is shown in Fig. 99.

These beetles are harmless when they appear singly; but sometimes they occur like the Rose-beetle in large swarms, and in such cases they riddle the foliage of the plants to such an extent that it resembles a piece of net, and only the larger veins are left undisturbed. The larvæ live in the ground, feeding there upon the roots of plants. As they cannot be reached in such quarters we have to fight the beetles themselves, which is readily accomplished by the use of arsenical poisons, by dusting the vines with fresh air-slaked lime, or by syringing them with a solution of whale-oil soap or strong tobacco water.

The following letter, published by the late Dr. Lintner in one of his excellent reports, will give an idea of the trouble such beetles may give the horticulturist: "And now we have the *Anomala marginata*. This is the too modest name of a bug, a species of May-beetle, which for "pure cussedness" can give the rose-bug points and come out ahead. It resembles the May-bug, is about half the size and in color is metallic bluish-green. This creature appeared for the first time last summer in this section just as the rose-bug was leaving, and promptly began devouring everything that the other hadn't time to eat. While blessed with the appetite of the rose-bug and the elephant combined, it is not so formal as the former, but brings all its luggage along and remains with us until fall. While the rose-bug has slighted us this summer, the *A. M.* has come again in millions. It began eating breakfast about six days ago and hasn't knocked off yet to get ready for lunch. Some of my vines are already quite defoliated. I have found them to some extent on blackberry, raspberry, and rose bushes, but its preference is the grape vine.

"I tried hand-picking and shaking them into a vessel with water and kerosene. I had three men working in a plat of thirteen hundred Cynthiana vines for an entire day. In this way they destroyed gallons of them. The next morning they were there in unbroken ranks, not a vacancy visible. I then tried spraying with London purple, a pound to one hundred and fifty gallons of water. If this treatment has caused them any unpleasantness I have yet to discover the fact. One might as well try to convince the Sabbatarians that there are other people in the world who have rights.

"If any of your readers having vineyards have been troubled by these pests and have succeeded in getting rid of them I would like to learn their methods. Kerosene emulsion might act as a deterrent, but I fear that it would spoil the grapes for wine-making. In the meantime, my emotions are too great for utterance. I think that Job makes no mention of ever having contended with the *Anomala marginata*. I would he were here. His opinion expressed in choice Chaldaic might possibly fit the case and give me some relief. J. K. H."

THE SPOTTED VINE-CHAFER.

(*Pelidnota punctata* Linn.).

This is a grape-vine pest in more southern and eastern states, where it devours the foliage, but is by no means a common beetle in Minnesota, hence not as destructive as elsewhere. It is a stout beetle, large specimens almost reaching an inch in length, of a clay-yellow color, with three large black dots near the margin of the elytra. These spots are very prominent in northern specimens, but are frequently very small or even absent in southern ones. The whole under side of the insect, including the legs, is black with a metallic green tint. The base of the head, between the eyes, the margin of the scutellum, and one spot on each side of the thorax are also black. The insect is nearly oval in form, with a polished surface.

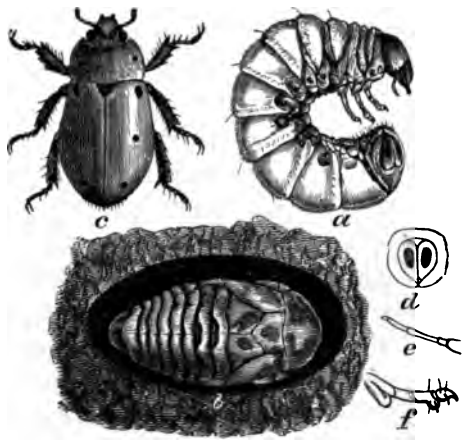


Fig. 100.—*Pelidnota punctata*, Linn. After Riley.

These beetles fly during July and August, and are only active during the day, flying from vine to vine with a heavy flight and a loud buzzing noise. Being so large and showy, they are easily detected at their work, and should be reduced in numbers by hand picking.

The female deposits her eggs in rotten wood, on which the larva feeds. The latter seems to prefer the decaying roots of apple, pear, hickory and some other trees. When full grown it is nearly two inches in length, of the usual shape of other "white grubs," but not so densely covered with hairs. It has a chestnut-brown head and a translucent white body, of a clearer white color than that of other and similar shaped larvæ; the last segment ends in a heart-shaped swelling, short and cut off squarely. Seen from the front it is marked as shown in the Fig. 100 at *d*. As soon as full grown the larva forms a slight cocoon of particles of the surrounding wood; in it it changes to a pupa from which the beetle escapes about ten days afterwards.

THE GOLDSMITH-BEETLE.

(*Cotalpa lanigera* Linn.).

This is without doubt one of our most beautiful beetles, and as it is rather common in our state, is well known, at least to our children, whose eyes are so sharp in detecting all sorts of strange looking or beautiful things. The beetle is almost one inch long, and is broadly oval in shape. It is of a lemon-yellow color above, glistening like burnished gold, with prismatic reflections on the top of the head and on the thorax. The under side is copper-colored, and is thickly covered with whitish wool, hence the name *lanigera* or wool-bearer. Even the otherwise polished upper surface is coated with an exceedingly fine down in fresh specimens; this, however, soon disappears, being rubbed off. Fig. 101, Plate III, shows this beautiful insect.

Although so common it can hardly be called a very injurious beetle. According to Saunders "this insect appears late in May and during the month of June, and is distributed over a very wide area, being found in most of the Northern States and in Canada; and although seldom very abundant, rarely does a season pass without some of them being seen. During the day they are inactive, and may be found clinging to the under side of the leaves of trees, often drawing together two or three leaves, and hold-

ing them with their sharp claws for the purpose of concealing themselves. At dusk they issue from their hiding places, and fly about with a buzzing sound among the branches of trees, the tender leaves of which they devour. The pear, oak, poplar, hickory, silver maple and sweet-gum all suffer more or less from their attacks. Like the common May-bug, this beautiful creature is attracted by light, and often flies into lighted rooms in summer evenings, dashing against everything it meets with, to the great alarm of nervous inmates. In some seasons they are comparatively common, and may then be readily captured by shaking the trees on which they are lodged in the daytime, when they do not attempt to fly, but fall at once to the ground.

The beetle is short lived. The female deposits her eggs in the ground at varying depths during the latter part of June, and,

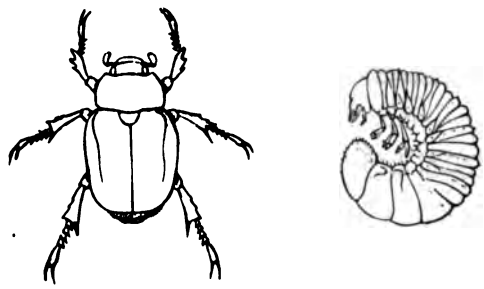


Fig. 102.—*Cota'pa lanigera*, adult and larva.—After Division of Entomology, U. S. Department of Agriculture.

having thus provided for the continuance of her species, dies. The lives of the males are of still shorter duration. The eggs are laid during the night, the whole number probably not exceeding twenty. They are very large for the size of the beetle, being nearly one-tenth of an inch in length, of a long, ovoid form, and a white, translucent appearance.

"In about three weeks the young larva is hatched; it is of a dull-white color, with a polished horny head of a yellowish-brown, feet of the same hue, and the extremity of the abdomen lead-color. The mature larva (Fig. 102) is a thick, whitish,

fleshy grub, very similar in appearance to that of the May-bug, which is familiarly known as the "white grub." It lives in the ground, and feeds on the roots of plants, and is thus sometimes very destructive to strawberry plants. It is said that the larva is three years in reaching its full growth; finally, it matures in the autumn, and late in the same season, or early in the following spring changes to a beetle."

Among the RHINOCEROS-BEETLES we have in Minnesota a number of species which do not possess a shape that is in the least like the one giving name to this group of beetles. Yet a few of them should be mentioned, as they are frequently sent to the office of the entomologist to be identified.

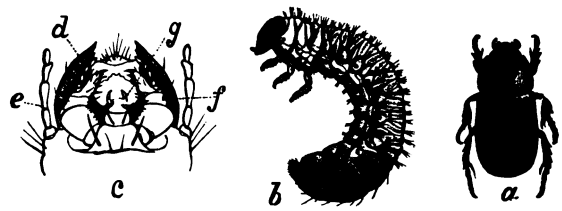


Fig. 103.—*Chalepus trachypygus*. Burm.—After Division of Entomology, U. S. Department of Agriculture.

It is well known that old manure harbors many grubs that look very much like those producing the May-beetles. Yet they are mostly of an entirely different character, as they change into black, polished beetles (Fig. 103), with faint longitudinal striæ upon their wing-covers. Such beetles have received the scientific name of *Chalepus trachypygus* Burm. The insects are harmless in Minnesota, notwithstanding their resemblance to the common white grub in the larval stage, and there is no danger in using the material, in which they thrive, upon lawns and in gardens.

Such good words can not be said about similar beetles of a dark brown color that are fairly common with us. Two species of *Ligyrus* are rather common in Minnesota, and a third, the *Aphonus tridentatus* Say, is also found in some numbers in cer-

tain seasons and localities. The "Sugar-cane Beetle" (*Ligyrus rugiceps* Lec.) sometimes causes considerable injury to sugar-cane and corn in the Southern States. It is shown in Fig. 104. *L. relictus* Say is exceedingly common in many places. Its larva feeds in rotten manure, and is frequently used as bait for fish.

In British Guinea beetles similar to the *Chalepus* mentiond above were so common near the fields of sugar-cane that it was a punishment to sleep near fires started to keep away the mosquitoes, and it was frequently a question which of the two

Fig. 104.—*Lygyrus rugiceps*, Lec.—After Division of Entomology, U. S. Department of Agriculture.

insects deserved the prize for being the greatest tormentor. Not that the beetles would bite, but they would crawl all over a person, and as their feet were not clad in slippers, but were shod with long nails in the form of sharp spines, their presence was far from being pleasant, especially as they were "thick as bees."

Among the members of the RHINOCEROS-BEETLES one species should be mentioned, as it is the largest of our American beetles; it is well named the *Rhinoceros-beetle,* (*Dynastes tityus* Linn.), as may be seen in the illustration (Fig. 105). The larva of this

Fig. 105.—*Dynastes tityus*, Linn. After Division of Entomology. U. S. Department of Agriculture.

giant feeds in the roots of decaying trees, preferring old cherry-stumps. The ash furnishes food for several allied but smaller species, both for the adult beetles and for their larvæ. In the South, where such bad-smelling beetles are fairly common, sometimes very much so, they may be attracted by bruising willows or other plants, and there the adults congregate to lap the sap. It is only the male that possesses such horns, which are simply ornamental, and not useful, as poorly fed larvæ produce males with very short horns. Notwithstanding the threatening aspect of these nocturnal beetles they are entirely harmless.

Among the FLOWER-BEETLES, so called because many of them feed upon the pollen of flowers which they visit for this purpose, are many enemies to our trees. Yet they are not always injurious in eating the pollen, as a number of them repay any small damage they may cause by pollenizing the flowers visited. Of course if they also eat ripe fruits, corn in milk, or other useful substances, they become troublesome. Most of these fairly large and frequently brightly colored beetles are flattened or nearly level on the back; the claws of the tarsi are of equal size.

THE SOUTHERN JUNE-BEETLE, OR FIG-EATER.

(*Allorhina nitida* Linn.).

This beetle, luckily not found in Minnesota, but occurring not far from our southern borders, is a good-sized insect, an inch

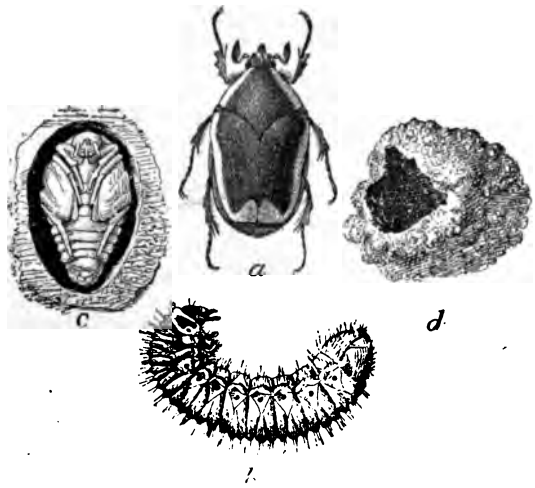


Fig. 106.—***Allorhina nitida***, Linn.—After Division of Entomology, U. S. Department of Agriculture.

or more in length, which during the day flies about with a buzzing sound like that of a bumble-bee, and like it usually close to the ground, excepting when invited by ripe fruit in the trees. It is somewhat pointed in front, of a velvety-green color, with the sides of thorax and head brownish-yellow. The under side is not velvety, but is polished metallic-green, like the entire head,

or is dark brown with a metallic-green tinge. The thighs of the legs are yellowish-brown. The beetle varies greatly in size and coloration; some measure not much more than half an inch, and some are also almost entirely dull brown with simply one or two broad longitudinal stripes of green upon their elytra. The insect is illustrated in (Fig. 106), which also shows the peculiar shape and sculpture of the head.

Fig. 107.—*Cetonia*, and larva traveling on back.

These beetles are very common in the South, and cause considerable damage. Their larvæ are found in richly manured soil, where they feed upon decaying vegetable matter, and not upon the roots of living plants. They are large white grubs, tougher than most of those of the common May-beetles, very hairy, with short legs, which forces them to travel on their backs instead of their legs when removed from their burrows. To enable them to travel in such a ridiculous manner they possess stiff bristles upon their backs, which propel them with ease and rapidity even over smooth ground. If put upon a table in the normal position,

they immediately turn upon their backs, and by the alternate contractions and expansions of their body segments they wriggle away in a straight line. This is also shown in Fig. 107.

Remedies against the adults are of little avail. Prof. Smith says that a heavy top dressing of kainit and tobacco has proved to be as effective as anything in dealing with the larvæ in the ground. If the trouble is only local, for instance if only small lawns are injured by their presence, kerosene emulsion, diluted ten times with water, and then washed into the soil by frequent waterings or by rain, has proved effective. This remedy has been very successfully applied in Washington. But as the larvæ feed upon decaying vegetable matter, or only in soils richly manured, their presence in large numbers is only injurious in dry weather, since the burrows made by them have the influence of drying the soil very rapidly. During a wet season the damage they cause is very slight, and many such grubs may be in a lawn without in any way revealing their presence. The insect is injurious only in the winged stage, and very decidedly so if at all numerous.

The genus *Euphoria* represents the more typical flower-beetles, which are distinguished by the margin of each wing-cover having near its base a large wavy indentation, which enables these sun-loving insects to expand their true wings very rapidly, hence they can fly as soon as they wish, without any long preparation, which is necessary in other cases described before. The mouth of such beetles is provided with a brush for sucking pollen. A number of such beetles are found in Minnesota, but only one is very common and decidedly injurious.

THE INDIAN CETONIA.

(*Euphoria inda* Linn.).

This is a yellowish-brown beetle, having the wing-covers covered all over with small and irregular black spots, which in some well-marked specimens form confused bands across the wing-cases. The whole insect is covered more or less densely

with short, fox-colored hairs. The under side of the body is black, and also hairy; the legs are dull black. The species varies greatly in color and markings; when quite fresh, especially late in summer, they are very much brighter than early in spring, after hibernating all winter in the ground.

These beetles are the earliest and latest of our flower-beetles. In spring, long before vegetation has started, they may be seen flying along close to the ground, with a loud, humming sound. Moist spots, especially near fresh manure, are frequently visited by them. During the early summer none are seen, but later they again become numerous, and now they frequent the flowers of thistles in great numbers. This would not constitute a crime, but these beetles are also very fond of both tassels and green silk of corn plants, and equally so of the young corn still in the milk, from which they suck the juice. Still later they invade the ripening fruits of all kinds, and burrow in them almost to the middle, as can be seen in the illustration, (Fig. 108, Plate I). In this manner they destroy ripe apples, pears, peaches and grapes; and if they do not actually eat these substances entirely they at least cause decay. Fruit left to dry is frequently invaded and injured by them. The normal food consists of the sweet sap which exudes from bruised and wounded trees, and it is not uncommon to see them swarm about a bleeding tree as would a swarm of bees. They are very active and fly almost as readily as the tiger-beetles; they are also very strong, and it is almost impossible to hold them between the fingers, excepting by using such force as to crush them.

Many years ago, when engaged by Dr. Le Baron to make illustrations of beetles for him under the direction of Prof. Riley, the writer had collected many balls of the common tumble-bug, so as to obtain its eggs and larvæ. Incidentally a white grub was added to these balls, which were kept in a tin box, and it was found that this larva ate into such balls. The larva transformed into the beetle under discussion.

When the beetles fly about in search of places in which to deposit their eggs, they may be seen in large numbers hovering

over refuse heaps coming from the kitchen. Here at the Experiment Station spoiled melons, potatoes and similar substances are carted away to a low place in the adjoining fields, where they decompose. This is the headquarter for such beetles and the ground is crowded with their larvæ. As there is no vegetation growing in these places the larvæ evidently feed only upon such decaying material. These, as well as those mentioned before as feeding in old manure, are almost entirely used for bait by the young fishermen living in the vicinity of our numerous northern lakes; they use them simply because in such places the angle-worms have not yet been introduced.

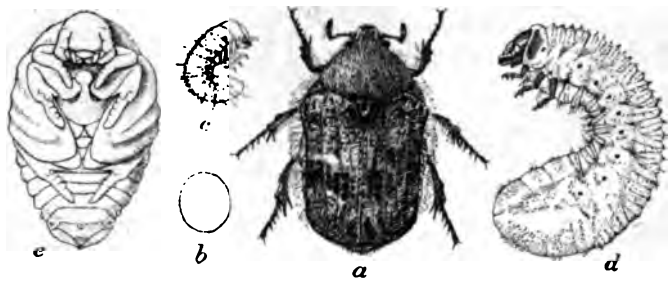


Fig. 109.—*Euphoria inda*, Linn.—After Division of Entomology, U. S. Department of Agriculture.

The larva of the *E. inda* is more robust than the common white grub, especially the abdominal segments. Mandibles and legs are short, the spiracles are prominent, and there is a yellow plate on the side of the first thoracic segment. These larvæ also travel upon their backs with great ease, but not so swiftly as those of the Fig-eaters. The different stages of this noxious beetle are given in the illustration (Fig. 109).

THE MELANCHOLY CETONIA.

(*Euphoria melancholica* Gory).

This beetle is a little smaller than the one just described, and is dark brown, almost black, with wavy impressed lines across the wing-covers, which are made prominent by being filled with

white scales. The insect looks polished and a little metallic, and has only the thorax covered with fine hairs, barely visible except in certain lights. It is not nearly so numerous, but otherwise has similar habits as *E. inda*. It is most frequently found in flowers. In the South, where it is much more common, it is often found about the holes made by the boll-worms in cotton-bolls, evidently enjoying the exuding sap. The beetle looks similar to the one illustrated in Fig. 107, but is also illustrated in Fig. 110.

Fig. 110.—*Euphoria melancholica*, Gory.–After Saunders.

Fig. 111.—*Osmoderma eremicola*, Knoch.–After Harris.

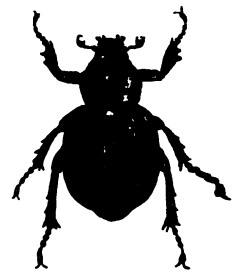


Fig. 112.—*Osmoderma scabra*, Beauv.—After Harris.

A number of other species of this interesting genus of beetles occur only in the nests of ants. It is difficult to account for their presence, but it is believed that their larvæ are beneficial to the colony of ants by cutting up the wood and roots found in the lower parts of the nest. They may, perhaps, also secrete some sweet liquid, used by the ants as food. At least some closely allied beetles, belonging also to the flower-beetles, to the genus *Cremastochilus*, are known to furnish food to the ants, hence are protected by them.

THE HERMIT FLOWER-BEETLES.

(*Osmoderma eremicola* Knoch).

This and the closely allied ROUGH FLOWER-BEETLE (*O. scabra* Beauv.), are rather large insects measuring an inch or more in length, the former species being the largest. Both species are

fairly common in Minnesota, and are frequently received by the entomologist to name them and describe their habits. The former, (*cremicola*), is a flat, deep mahogany-brown beetle, nearly smooth and highly polished. The latter, (*scabra*), is purplish-black, and has the wing-covers roughened with irregular and coarsely punctured striæ; it has a bronzed appearance. Both beetles are nocturnal in their habits and hide during the day near the base of trees. Though not frequently seen they are common enough. The insects feed upon the sap of injured trees, but have also been seen enjoying a ripe apple. Fig. 110 shows *O. cremicola* and Fig. 112, *O. scabra.*

The larvæ of both species live in the decaying wood of the apple, as well as that of the cherry and other trees; here they consume the wood and induce more rapid decay. The larva is a large, fleshy "white grub", with a hard and reddish head and horny scales on the prothorax. When mature, late in autumn, each larva forms for itself an oval cell of the fragments of wood, which are cemented together with a glutinous material so as to be water proof. Inside this cocoon it undergoes its transformations, appearing as a beetle during the month of July, August, or early September. Frequently a number of such larvæ are found together in the same place, and in this case they can cause considerable injury.

Some closely allied beetles are also lovers of fruit and flowers, but cause no damage. The peculiarly marked *Gnorimus maculatus* Knoch was once found in large numbers eating the flowers of the shadberry, a plant frequently grown not only for ornamental purposes but also on acount of its pleasantly flavored fruit. Several species of a still smaller species of flower-beetles belonging to the genus of *Trichius* are very fond of flowers, and especially so of the rose; here they sometimes cause much injury by eating both pollen and petals. They are diurnal in their habits, and are readily detected in such flowers. Some of these beetles are very pretty, of a brown, black, dark blue, or even metallic green color, marked with white lines, and an abundance of soft hairs, as may be seen in Fig. 113, Plate VI.

The vegetable-feeding lamellicorn beetles contain no directly beneficial insects, but a number of more or less injurious ones, causing, generally speaking, but slight losses. But most of their larvæ are decidedly injurious, and all are similar in shape to the well known "white grubs". Prof. Smith writes that:

"Taken as a whole, the lamellicorns contain no directly beneficial insects, and the white-grub larvæ are in many cases injurious when they feed on the roots of cultivated plants. Where a variety of cultivated crops follow each other, there is little chance for their excessive development, and frequent rotation is therefore indicated, with as short a period in grass as may be. As the beetles in most cases appear in spring, and oviposit late in May or in June, land bare at that time will probably escape. Fall sowing of crimson clover, to be turned under by the middle of May or before, will in some cases protect the land and act as a green manure if required; or it may be allowed to remain until mature to make hay, and, if then ploughed and put into potatoes or some crop which the white grubs do not attack, such as are then in the ground will be starved out. Where white grubs are abundant, strawberries should not follow sod or other grass crops directly, and the beds should be kept clean, at least through the second year. Where the culprits are species of *Lachnosterna*, fall ploughing is indicated, since this will turn out the newly formed beetles at an unseasonable period, and will cause their death in most cases".

E. PLANT-EATERS.

(*Phytophaga*).

We now reach the large series of beetles which belong to the *Phytophaga* or *Plant-eaters*, beetles distinguished by very long and thread-like feelers, and which possess apparently four-jointed tarsi, with the third joint deeply lobed. This series of more or less injurious beetles is divided into two families, the *Cerambycidae* or Long-horned Beetles, (Bock-kæfer of the Germans), and the *Chrysomelidae*, or Leaf-beetles.

There is still another small family of beetles that is located between the lamellicorns and the true cerambycids. It is the family *Spondylidae,* composed of but a few species of beetles. One of them is very common in Minnesota, especially under the bark of pine trees. It is the BROWN PARANDRA, (*Parandra brunnea* Fab.), an insect of a mahogany-brown color, highly polished, with short feelers, which have deep impressions in which are situated the organs of special sense. It is shown in (Fig. 114, Plate IV).

FAMILY LONG-HORNS.

(*Cerambycidae*).

This large family contains about six hundred described species in North America alone. The beetles composing it are of medium or large size, graceful in form, and some are very beautiful in color and markings. Their body is oblong, often cylindrical, with a vertical, broad head armed with large mandibles. The eyes are peculiar, being hollowed out (*lunate*) on the inner side, with the feelers implanted in the hollows; the latter are long, sometimes longer than the whole body, tapering towards the tip, especially in the males, and are, with the exception of the *Prionidae,* composed of eleven joints. Their legs are also usually very long, and the joints of the tarsi, with long claws, are well adapted to anchor them safely upon the trees on which they hide and feed. Nearly all long-horns can run and fly with almost equal ease, but some species living in the Western treeless prairies possess no true wings. As a general rule, however, these beetles depend more upon hiding for their safety than upon running or flying, and in many cases their colors and markings blend exceedingly well with the objects upon which they rest. When held between the fingers some of them can produce a sort of indignant squeaking by rubbing together the prothorax and mesothorax; but some of them also produce this sound, ***stridulation,*** to call their mates.

The larvæ are borers, living in the solid parts of trees and

shrubs, or beneath the bark. They are white or yellowish, with a soft body, in which the joints are well separated by deep incisions, and which tapers slightly from head to tail. The first joints are usually enlarged and hammer-shaped, and covered with a horny plate, but are not flattened as are those of the "saw-horned borers" already described. Some larvæ possess the usual number of very small thoracic legs, but the majority have no legs at all, and move up and down in their burrows by alternate contractions and extensions of the body, or by means of peculiar projections or hunches on the segments. Many of them keep one end of their burow open, through which they push out the frass, (chips and castings), and their presence is often detected by the little heaps of sawdust on the bark or beneath it on the ground; others are, however, entirely enclosed in their burrows, leaving the frass in a compact mass behind them as they extend their burrows in front.

In contradiction to the "saw-horned" or "flat-headed borers" they are frequently called "hammer-headed borers," or "round headed borers". All these larvæ possess powerful jaws which enable them to chew food composed of the hardest wood. After passing one, two, or three years in the larval state they transform to pupæ inside the burrows, and soon afterwards change to the adult beetles. Before changing to a pupa the larva in many cases transforms a portion of the long burrow into a pupal chamber by means of a plug of chips. With few exceptions such larvæ attack only dead or dying trees, or plants weakened in some way, perhaps by fire, by transplanting, by pruning, by storms, or by insects belonging to other families of beetles.

This extensive family is divided into three sub-families, which are separated as follows:

A. Sides of the prothorax with a sharp margin.....*Prioninae.*

A. A. *Prothorax not margined.*

B. Front tibiæ not grooved; palpi never acute at tip..*Cerambycinae.*

B. B. Front tibiæ obliquely grooved on the inner side:
palpi with the last segment cylindrical and pointed. *Laminiae*

The PRIONIDS (*Prioninae*) are large, sometimes very large beetles. They have the sides of the prothorax prolonged outwards into a thin, more or less toothed margin. The wing-covers are usually leathery in appearance, and of a brownish or blackish color.

THE BROAD-NECKED PRIONUS.

(*Prionus laticollis* Drury).

This gigantic borer, not uncommon in our state, measures in the larval stage from two and a half to three inches in length; it is of a yellowish-white color, with a small, horny, reddish-brown head, to which are fastened exceedingly dark and hard jaws; a bluish line marks the center of the back. This large grub cuts a cylindrical hole a little below the surface of the ground, into the roots of plants, such as the grape-vine, blackberry, oak, cherry, and apple. If the root is small, barely large enough to contain the larvæ, nothing but a thin skin of bark is left to hide the intruder. The same larva is sometimes also found in open prairies away from other roots than those of the plants growing in such places. In such cases the borer is an external feeder, but it never grows to the formidable size of others feeding inside of roots, and as a consequence the adult beetle of this form found in prairies are much smaller, and of a very much lighter color. The larva feeds for about three years, when it changes toward the end of June to a pupa within the root it had occupied. Of course where such borers abound the injury is great, and if a tree is badly infested nothing remains but to dig it out and burn it. Even large trees can be killed by such borers; the grape and apple seem to be able to stand the injury better than other plants, but they also suffer very much, even if not killed outright. In berry patches infested with such insects a sudden wilting of the plants in a hill, or part of a hill, indicates their presence, and steps should at once be taken to find and destroy them.

The beetles, which vary in length from less than one inch to two inches, and even more, are of a pitchy-black color; in the

prairie forms they are sometimes yellowish-brown. They possess powerful jaws; the twelve-jointed feelers are in the female rather slender, in the male longer, stouter and toothed; the thorax is short and wide, armed at the sides with three teeth. The leathery wing-covers have three slightly elevated lines each, and are thickly punctuate. The female is a rather bulky beetle, the male much smaller with a shorter body. The illustration, (Fig. 115), shows this beetle in its various stages, and Fig. 116, Plate VI one still in its burrow but ready to leave.

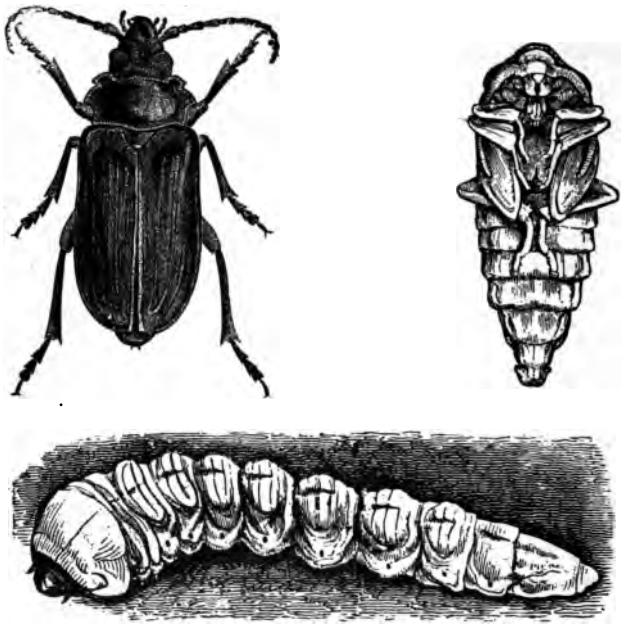


Fig. 115.—*Prionus laticollis*, Drury.—After Riley.

Another species (*P. imbricornis* Linn.), or the "Tile-horned Prionus," is also found in Minnesota; it is similar to the one described, and has the same habits, but is not so common. The early stages are almost identical in appearance, but the male beetle has received the above name because the joints of the feelers overlap one another like tiles on a roof. There is another

Fig. 117.—*Prionus imbricornis*, Linn. Male.—After Riley.

Fig. 117½.—*Phymatodus amœnus*, Say.—After Division of Entomology, U. S. Department of Agriculture.

rather remarkable difference in these two species, viz.: *laticollis* has in both sexes twelve-jointed antennæ, while in *imbricornis* the feeler of the male is composed of nineteen, that of the female of about sixteen joints. Fig. 117 shows the male of *imbricornis*.

The TYPICAL CERAMBYCIDS, (*Cerambycinae*), contain about four hundred North American species, divided into more that one hundred genera.

THE GRAPE-VINE PHYMATODES.

(*Phymatodes amoenus* Say).

This beautiful beetle is frequently sent to the entomologist as being destructive to the grape-vine. But this is not exactly the case, although there is no doubt that it is frequently found about such plants. But it only feeds in its larval stage in dead or dying wood, hence all vines properly trimmed will not harbor it. The dead vines of the wild grape, however, offer an excellent abode for it. The beetles are bright blue, with a yellowish-red thorax. They appear in spring, and deposit their eggs in dead or dying canes. The beetle is shown in Fig. 117½.

Closely allied species of *Phymatodes* are frequently very numerous about cordwood; here they breed in such numbers that the bark is often loosened by their larvæ, and slips off entirely

during the following spring. The wood-men on that account call them "Bark-slippers." Other species in the Southern States are very apt to injure tan-bark. Trees cut in summer or early in autumn, after the beetles have disappeared, are not attractive to them in the following season, and escape injury.

Fig. 118.—*Hylotrupes bajulus*, Linn.—After Brehm.

Hylotrupes bajulus Linn., a beetle very similar in form to the species of *Phymatodes,* is shown in Fig. 118; it is one of the few longicorn beetles that burrow in the larval state in dead wood, even after it has been used for building purposes.

THE BELTED HICKORY-BORER.

(*Chion cinctus* Drury).

This common beetle, (Fig. 119), distinguished by very narrow wing-covers, which are armed with two little thorns toward the tips, is of a hazel color, with a tint of gray produced by the short hairs covering it; it is also marked by an oblique ochre-yellow band across each wing-cover, not always present, however. The thorax is armed with a short spine on each side. The feelers

of the male are more than twice the length of the body, which measures from three-quarters of an inch to one and a quarter inch in length.

The larva of this beetle feeds in the wood of hickory and walnut. Here it forms long galleries in the trunk in the direction of the fibers of the wood, and in such a gallery it later undergoes the transformations to a pupa and adult.

Besides the trees mentioned above as furnishing food to these larvæ, others are equally infested, as the oaks; even plum and apple trees do not escape.

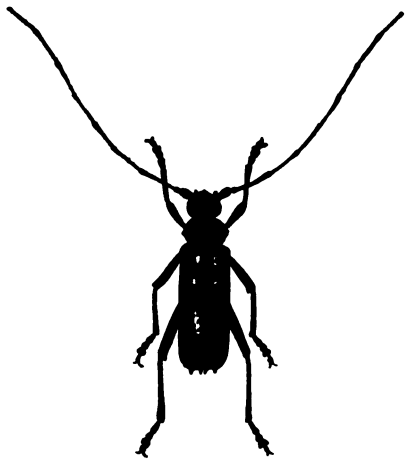


Fig. 119. — *Chion cinctus*, Drury. — After Harris.

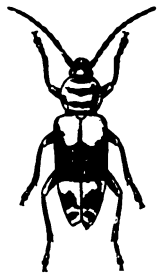


Fig. 121½.—*Cyllene decorus*, Oliv.— After Leconte.

OAK PRUNER.

(*Elaphidion parallelum* Newm.).

The name "oak-pruner" does not mean that the larvæ of these destructive beetles devote all their attention to oaks; they are also found in the apple, hickory, cherry, and other trees. The name "pruner" is very descriptive as the larvæ, when nearly full grown, girdle the twigs and branches inhabited by them from the inside, not the outside, so that the first high wind of autumn and

early winter breaks them off, dropping twig and larva to the ground. To girdle a twig from the inside is a nice trick, and it is difficult to explain how the larva succeeds in performing it. When we look at one of the squarely cut off twigs we can detect that it has been cut in a spiral manner. The purpose of cutting them off seems to be plain, being done to prevent the drying of the wood, which in contact with the ground and covered with snow during the winter, is not apt to become too dry for the requirements of the enclosed insect. In such burrows, usually made in the tips of twigs and smaller branches, the larva winters, and completes its transformation in the month of June or July following.

Under infested trees we can find such fallen twigs in large numbers during the fall, and as they contain the culprit it is of course very simple to gather and burn them. These insects are, however, not an unalloyed evil, as they tend to make our shade trees near the house much denser by forcing the plant to produce a number of small twigs instead of a few large ones.

The insect also attacks the wood of young shoots, especially if these should have been injured by fire, or by the tramping of cattle. The writer has seen an extreme case, in which these insects in less than five years destroyed all the young growth of trees over an area of several hundred acres. In this case the land was covered with a very dense growth of black oak, poplars, hazel and other plants. As soon as cattle were permitted to force their way through this tangle of small trees to reach a lake surrounded with pastures, narrow cattle paths were first formed which soon widened to broad avenues, as the bruised trees invited destruction by all kinds of insects, but especially by these pruners. Their presence could easily be detected by the fact that the whole ground was covered quite deep with pruned twigs. Five years later only a few stumps of the larger trees, with the exception of some few poplars and willows that sprang up as soon as the oaks disappeared, remained.

The adult beetles are very elongated, brown, covered with a whitish, mottled pubescence; they have long and rather stout an-

tennæ, which in some species are armed with horns; their narrow wing-covers possess two smaller pointed projections at their posterior extremity, one on each side.

A number of species occur, all similar in general appearance and habits. The PARALLEL ELAPHIDION (*E. parallelum* Newm.), is the most common one. The female lays eggs near the axil of one of the leaf buds, where the young larva also enters the twig, enlarging the channel as it increases in size.

The APPLE-TREE PRUNER, (*E. villosum* Fab.), is very similar in general appearances. The feelers of the male are longer than the body, which is covered with short grayish hairs, which in some places are crowded together on the thorax and elytra, forming pale spots. The under side of the body is chestnut-brown. Prof. Saunders describes the habits of this species of beetle as follows:

"The peculiar habits and instincts of this insect are very interesting. The parent beetle places an egg in the axil of a leaf on a fresh green twig proceeding from a moderate sized limb. When the young larva hatches, it burrows into the center of the twig, and down towards its base, consuming in its course the soft pulpy matter of which this part of the twig is composed. By the time it reaches the main limb, it has become sufficiently matured to be able to feed upon the harder wood, and makes its way into the branch, when the hollow twig is vacated, gradually withers, and drops off. The larva, being now about half grown, eats its way a short distance through the middle of the branch, and then proceeds deliberately to sever its connections with the tree by gnawing away the woody fiber to such an extent that the first storm of wind snaps the branch off. This is rather a delicate operation for the insect to perform, and requires wonderful instinctive skill, for should it gnaw away too much of the woody interior the branch might break during the process, an accident which would probably crush the workman to death; but the insect rarely miscalculates; it leaves the bark and just enough of the woody fiber untouched to sustain the branch until it has time to make good its retreat into the burrow, the

opening of which it carefully stops up with gnawed fragments of wood. If the limb be short, it severs all the woody fibers, leaving it fastened only by the bark; if longer a few of the woody fibers on the upper side are left; and if very long and heavy, not more than three-fourths of the wood will be cut through. Having performed the operation, and closed its hole so that the jarring of the branch when it fall may not shake out the occupant, the larva retreates to the spot at which it first entered the limb. After the branch has fallen it eats its way grad-

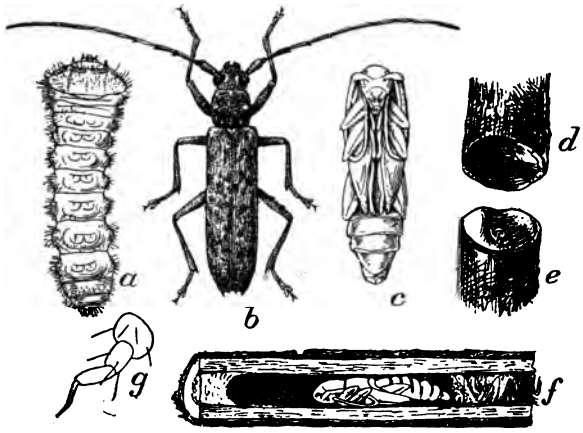


Fig. 120.—*Elaphidium villosum*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

ually through the center of the limb for a distance of from six to twelve inches, when, having completed its growth, it is transformed to a pupa within the enclosure. Sometimes this change takes place in the autumn, but more frequently it is deferred until the spring, and from the pupa the beetle escapes during the month of June.

"The larva, (Fig. 120), when full grown is a little more than half an inch long, thickest towards the head, tapering gradually backwards. The head is small and black, body yellowish-white, with a few indistinct darker markings. It has six very

minute legs attached to the anterior segments. The pupa is about the same size as the larva, of a whitish color, and is also shown in its burrow.

"Birds are active agents in the destruction of these larvæ; they seek them in their places of retreat and devour them. Should they at any time become very numerous they may easily be disposed of by gathering the fallen branches and burning them before the insect has time to mature."

Several other beetles of this genus are also destructive, and especially so in the orange-growing states, where the UNARMED GIRDLER (*E. inerme* Newm.), destroys the twigs of orange trees. It is called "unarmed" because the beetle lacks the two spines at the tip of the elytra. Of course it is not necessary for our fruit growers to prepare themselves to fight this beetle.

THE TWO-SPOTTED HICKORY BORER.

(*Tylonotus bimaculatus* Hald.),

This beetle, (Fig. 121, Plate V), equal in size to the "apple-tree pruner," but broader, is a rather pretty insect, dark-brown, with either two yellowish spots near the tips of the elytra, which are unarmed, or with four spots, two of which form almost a band across the wings. Our specimens in Minnesota are almost invariably four-spotted.

The larva of this beetle feeds in the wood of hickory, butternut, and walnut, and is sometimes quite numerous and correspondingly injurious by destroying the terminal twigs of such useful trees. It occurs also under the bark of the white or paper birch, and in the ash.

THE TWO-SPOTTED MOLORCHUS.

(*Molorchus bimaculatus* Say).

This peculiar small beetle, about a third of an inch in length, is not mentioned because it is very destructive, but because it differs from nearly all our longicorns in having the wing-covers only half as long as the abdomen. It has a very

slender body, black, with head and thorax coarsely punctured; each of the short wing-covers has a yellowish dash almost parallel with the inner margin; the feelers and legs are brownish.

The larva of this beetle has been found in hickory twigs and branches; also in those of the maple. The beetles themselves are very active, and fly about flowering shrubs during the warm and sunny days of June and July.

We have a large number of very prettily marked longicorn beetles which fly about during the day as actively as wasps, visiting flowers for the sake of their pollen and honey, and which race up and down the trees in which they were born or in which they intend to lay their eggs. Those interested in flowers, and especially in golden-rods, must have seen such beetles, usually of a dark brown or almost black color, marked with wavy golden-yellow lines across their wing-covers. A species not uncommonly found upon golden-rods in our prairies, away from any forests, is shown in Fig. 121½. It is *Cyllene decorus* Oliv. Some similar beetles are very destructive in their earlier stages, and on this account it is, or was, even forbidden to plant such trees as the locust. Maples, ash, hickories, walnut, butternut, and other trees suffer equally, and therefor two of the insects will be described and illustrated.

THE PAINTED HICKORY-BORER.

(*Cyllene pictus* Drury).

This and the LOCUST-BORER (*C. robiniae* Forst.), are very similar in size, color and markings. The illustrations (Figs. 122 and 123) on Plate IV are excellent ones and were kindly loaned by Prof. Webster, the entomologist of Ohio.

The former, (*pictus*), appears as a beetle only in spring; the latter, (*robiniæ*), only towards fall, when large numbers of them may be collected upon the flowers of the beautiful golden-rod. The "painted hickory-borer" is a velvety black beetle, with numerous narrow, pale-yellow transverse bands upon the elytra and across the thorax. With a little imagination one of these

wavy lines looks like a "W". The legs are dark-red as are the feelers; in the "locust-borer" the yellow color is darker, and the wavy lines are usually a little broader.

The larvæ of both bore under the bark of their respective food-plants, and later into the solid wood, where they attain their growth in less than a year. The locust-borer is a serious pest, making the growing of the sweet-scented locust almost impossible in many localities, and in not a few places such trees have been completely destroyed. As soon as a tree attains a moderate size it is riddled with the large holes made by the larvæ, and for a few years leads but a sickly life, eventually dying down to the ground.

Prof. Packard in his fine work: "Insects Injurious to Forest and Shade Trees" gives the following remedies against such borers as the *robiniae;* "An excellent way to save a valuable shade tree from the attacks of this borer is to thoroughly soap the trunk late in August, so as to prevent the beetle from laying the eggs early in September. All insects breathe through little holes; now, if a film of soap, or grease, or oil of any kind closes the openings of these breathing pores, the air cannot enter the respiratory tubes which ramify throughout the interior of the body, and the insect dies by asphixiation, i. e. drowns." Harrison states that whitewashing and covering the trunks of trees with grafting composition may prevent the female from depositing her eggs on isolated trees. A coating of oil, whether it really kills the worms in the manner suggested or not, is an excellent remedy, as it is offensive to the female beetles. It is an improvement, however, to add a little Paris-green or London-purple which fill the cracks with a fine film of these poisons; if eggs are deposited the larvæ hatching from them will be poisoned in eating their way into the wood. To whitewash a tree looks bad, and moreover is apt to attract the beetles, as insects of this kind are attracted to white objects.

An allied, but larger species, varying from velvety brownish-black and unspotted to an intense black beetle with bright yellow spots, sometimes united into wavy bands, is getting rather com-

mon in our state, where it infests the ash. It is very destructive when at all numerous.

A large number of smaller but equally beautiful beetles belong to this family. All are more or less injurious, but not to fruit-producing plants, being most abundant in evergreen forests.

Some few other longicorn beetles also belong here, which are more or less injurious to wild plants. In places where the elderberries are utilized a most beautiful beetle is sometimes injurious, because its larva bores and feeds in the pith of these plants. The beetle is quite common in June and July, and is found resting upon the foliage, but is wide awake and ready to seek safety in flight.

The ELDERBERRY BEETLE, (*Desmocerus palliatus* Forst.), is dark blue with greenish reflections. The basal half of the wing-covers is orange-yellow, and in strong contrast with the rest of the body. The black feelers have the middle joints thickened at the outer ends, so that they look like a series of knots, for which reason the beetle is sometimes called "Knotty Horn". It is shown in Fig. 124, Plate VI.

There is another large series of very beautiful longicorn beetles which are frequently observed, as they are visitors to our flowers, in which, covered with pollen, they are sometimes barely visible. On account of this they are certainly beneficial, even if their larvæ burrow into the wood of trees. The wild chestnuts in more southern regions would not produce so many nuts if their flowers were not so profusely scented, thus attracting beetles of this kind, which are not slow to accept such invitations.

To show how at least one of these beetles looks, the description of *Gaurotes cyanipennis* Say, an insect living in the wood of butternut, is given. The beetle is black, tinged with copper; the feelers and legs are reddish-brown, and the elytra are of a most beautiful violet, blue or blueish green color, and are highly polished. It is shown in Fig. 125, Plate IV, and a member of the genus *Strangalia* in Fig. 126.

Among the LAMIID LONGICORNS (*Lamiinae*) we also have a large number of fine beetles, some of which are decidedly

injurious, not alone to forest trees, but to fruit-producing trees as well. Members of this group of beetles have a rounded prothorax, frequently armed with rather long thorns, but not always so; their fore-tibiæ are grooved on the inner side, and the last segment of the palpi is cylindrical and pointed.

Fig. 126.—*Strangalia spec.*—After Brehm.

THE AMERICAN CURRANT-BORER.

(*Psenocerus supernotatus* Say).

It is not uncommon at all to find a small larva in the branches and smaller shoots of our currant bushes, which in early spring changes to a small, brown, and slightly flattened beetle, rarely exceeding one-quarter of an inch in length. It is beautifully marked, although some specimens are almost unicolored. Bright-colored specimens are clothed with white hair, which is grouped so as to form two white spots towards the end of the wing-covers, frequently so broad as to join at the suture, in which case they are lunar in shape. In the center is another fine and wavy white line, sloping from the sides back to the suture, and enclosing an almost black space. The scutellum is also white.

If this insect (Fig. 127) should become abundant enough to become troublesome, it can be held in check by close pruning during the late fall or winter; the cuttings should be burned before spring to destroy the larvæ in them. According to Dr. Hamilton this beetle sometimes hibernates, as he found three of them in the folds of a *Cecropia* cocoon taken in February from the currant bush.

Although not an enemy to fruit-producing plants the SAWYER (*Monohammus confusor* Kirby) is so frequently seen, so destructive to pines, and so often received by the entomologist to be named, that its life-history will be given in a few words.

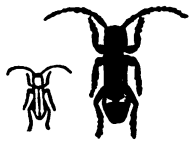


Fig. 127.—*Psenocerus supernotatus*, Say. After Saunders.

Fig. 128.—*Monohammus confusor*, Kirby.–After Division of Entomology, U. S. Department of Agriculture.

It is a beautiful brown or gray beetle, covered more or less densely with a silky down, most prominent upon the thorax, for which reason it is sometimes called the "Silver-bug." The elytra are mottled, with raised black dots or dashes; the thorax is armed upon each side with a large thorn. The beetle measures about one inch and a quarter in length, and is readily recognized by the long feelers, which in the female are as long as the body, and in the male twice as long. These enormously long antennæ

are in constant motion when the beetle is running about and point forward in this case; when the owner is asleep they bend backwards, and are close to the body.

The larva bores in the sound wood of pine and fir, making when full grown, a large hole, half an inch in diamater. It changes to a pupa, and soon afterwards to the adult beetle. Such borers are exceedingly numerous in our neglected pine forests, invading all the trees that are injured by fire, or which are bruised by trees felled by the axe of the wood-cutter. When everything is quiet the gnawing of such larvæ can be plainly heard in the dry trees, which act as a sort of a sounding board. This insect is shown still in its burrow in Fig. 128.

There is another insect, not as bulky, but nearly as long, with equally long horns, which in the Southern States is quite destructive to the mulberry. Our mulberry bushes are also invaded by a similar, but much smaller beetle, which is, however, not numerous enough to cause much injury.

The hickory is invaded by a number of borers, which in more southern regions cause the loss of many young trees. THE COMMON HICKORY-BORER (*Goes tigrinus* De Geer), and the BEAUTIFUL HICKORY-BORER (*G. pulchra* Hald.), as well as *G. oculatus Lec.* and *G. debilis Lec.* belong to this genus.

THE BEAUTIFUL HICKORY-BORER.

(*Goes pulchra* Hald.).

This insect (Fig. 129, Plate VI) is well named *pulchra*, meaning beautiful. It measures a little over an inch in length, is reddish-brown, and marked with dark brown in such a manner that across the wing-covers a band is formed, which gradually shades off into the general color of the beetle towards the tip. This marking of the wing-covers is produced by a close belt of fine hairs.

The beetle deposits eggs upon the different kinds of hickories, frequently selecting for this purpose the smaller trees, an inch or more in diamater. The presence of the larvæ inside

sometimes forces the trunk to enlarge at that point, so that a large gall-like swelling is produced. This of course kills the tree, which during a heavy wind breaks at this weak place.

There are a large number of small grayish longicorns, more or less sprinkled with white scales arranged in larger spots or irregular wavy lines, which infest all sorts of trees, and among them our fruit trees. The beetles look like the dead bark upon which they are usually found hiding. Most of them have their short thorax armed with a minute spine on each side, but this is not always the case. A few of the more important ones will be described. In case they should at any time become numerous enough to become destructive the dead twigs should be cut off and burned, and an alkali wash applied to the bark, as recommended against the "Round-headed Apple-tree Borer," a beetle to be described later.

THE LONG-HORNED BORER.

(*Leptostylus aculifer* Say).

This beetle (Fig. 130) is rather robust in shape, with long tapering feelers, ringed with black and white. It is of a brownish-gray color, with numerous small thorn-like points upon the wing-covers, and a V-shaped band, margined with black, a little behind the middle of the elytra. Some well marked and fresh specimens are little beauties, being almost silvery white, with dark dots on the band already mentioned. The insect measures a little more than one third of an inch in length. It is most common during August, when it may be found hiding on the trunks of apple-trees. Here, and also in other trees, it lays eggs, which shortly afterwards hatch into small grubs, which enter the tree, burrowing under the bark.

Leptostylus macula Say, a very similar beetle, is also often found upon old apple-trees; it probably feeds in them as a larva.

The closely related genus *Liopus* also furnishes a contingent of beetles which feed in our orchards. These beetles are smaller and more elongated. In the next genus we find a small beetle which occurs in large numbers in old apple-trees.

THE APPLE LEPTURGES.

(*Lepturges facetus* Say).

This insect, though very small, as seen in the line under the illustration, (Fig. 131), is a very handsome, slender beetle, in some cases much less than a quarter of an inch long; it is of a pale ash-gray color, with a purplish tinge. The rather long and hairy feelers are yellowish-brown, and are ringed with black at the tips of each joint. The smooth wing-covers possess an irregular dark spot on their anterior portion, and a broad black band across the posterior part, just leaving the tips pale-

Fig. 130.—*Leptostylus aculifer*, Say. After Saunders.

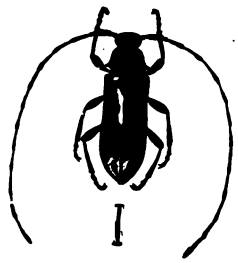


Fig. 131.—*Lepturges facetus*, Say. After Saunders.

Fig. 132.—*Oncideres cingulatas*, Say. After Riley.

gray; other blackish spots and streaks are found elsewhere. These beetles occur most numerously during late June and in July, when they are engaged depositing their eggs on the bark of the branches, which the young larvæ enter, and in which they undergo their transformations before the next summer.

The larva has the usual form of such borers, is about a quarter of an inch long, slender, with the anterior segments enlarged and the abdomen rather blunt. It is entirely covered with fine and short hairs.

Many other beetles, which are all of about the same size, similar color and markings, are more or less injurious to fruit trees. By beating the small dead twigs of some trees, as the oak, chestnut, hickory and others, large numbers will fall into an

inverted umbrella held beneath, and this is one of the methods used by collectors of beetles to collect their pets.

THE TWIG-GIRDLER.

(*Oncideres cingulatus* Say).

This fine beetle, a little more that half an inch in length, has a very elegant but modest appearance, being of a brownish-gray color with dull reddish-yellow dots, and having a broad gray band across the middle of the wing-covers. The antennæ are longer than the body.

It is of rare ocurrence in Minnesota and not mentioned because it is injurious, but on account of its habit of girdling the twigs of the hickory, pear and other trees, and its interesting mode of laying eggs. The female lays an egg in a twig or branch, which it then girdles a little distance below, eating a groove about one-tenth of an inch wide, and as deep, so that a high wind breaks it down. The foliage on such a twig wilts at once, and the wood is then in the exact condition desired by the larva, which undergoes its transformations undisturbed by growth or undesirable moisture. Sometimes shade trees are also attacked, but a careful gathering and burning of the fallen wood keeps the insect in check.

The illustration (Fig. 132) shows the female at work. Sometimes a number of twigs are thus amputated, and it has been reported that a persimmon branch not more than two feet long contained as many as eight eggs, one egg being placed under each of the successive side shoots; in another case seven eggs were crowded together in a small hickory branch only three inches long, which shows that this insect can become decidedly injurious if at all numerous.

THE ROUND-HEADED APPLE-TREE BORER.

(*Saperda candida* Fab.).

This is one of the worst and most familiar orchard pests, preferring to bore into the apple, although the quince is as badly

infested; it also occurs in the pear, hawthorns and some other plants. The beetle appears late in June or July, and is not found in large numbers in our state. Prof Saunders gives the follow-condensed description of this beetle and its work:

"The Round-headed Apple-tree Borer is a native of America whose existence was unrecorded before 1824, when it was described by Thomas Say. The year following, its destructive character was observed about Albany, N. Y. It is now widely and generally distributed, and probably it was so at that time, although unnoticed, since it inhabits our native crab and thorn bushes, and also the common June-berry, *Amelanchier canadensis*. While preferring the apple, it also makes its home in the quince, pear and mountain-ash. In its perfect state it is a very handsome beetle, about three-fourths of an inch long, cylindrical in form, of a pale-brown color above with two broad creamy white stripes running the whole length of its body; the face and under surface are hoary-white, the antennæ and legs are gray. The females are larger than the males and have shorter antennæ. The beetle makes its appearance during the month of June and July, usually remaining in concealment during the day, and becoming active at dusk.

"The eggs are deposited late in June, in July and most of August, one in a place, in an incision made by the female in the bark of the tree near its base. Within two weeks the young larvæ are hatched, and at once commence with their sharp mandibles to gnaw their way to the interior.

"It is generally conceded that the larva is three years in reaching maturity. The young ones lie for the first year in the sap-wood and inner bark, evcavating flat shallow cavities, about the size of a silver dollar, which are filled with their saw-dust like castings. The holes by which they enter being small, they are soon filled up, though not until a few grains of castings have fallen from them. Their presence may, however, be detected in young trees from the bark becoming dark-colored, and sometimes dry and dead enough to crack. Through these cracks some of the castings generally protrude and fall to the ground in

a little heap; this takes place especially in the spring of the year, when, with frequent rains, the heaps become swollen by the absorption of moisture. On the approach of winter the larva descends to the lower part of its burrow, where it doubtless remains inactive until the following spring.

"During the next season it attains about half its growth, still living in the sap-wood, where it does great damage, and when, as often happens, there are several of these borers in a single tree, they will sometimes cause its death by completely girdling it. After another winter's rest, the larva again becomes

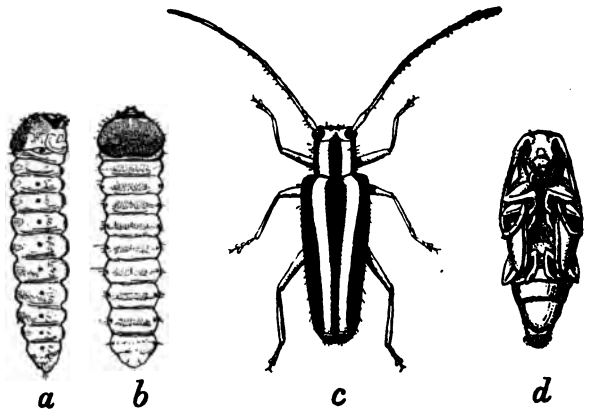


Fig. 133.—*Saperda candida*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

active, and towards the end of the following season, when approaching maturity, it cuts a cylindrical passage upwards, varying in length, into the solid wood, afterwards extending it outward to the bark, sometimes cutting entirely through the tree, at other times turning back at different angles. The upper part of the cavity is then filled with a sawdust-like powder, after which the larva returns to the part nearest the heart of the tree, which portion it enlarges by tearing off the fibers, with which it carefully and securely closes the lower portion of its gallery, so as to protect it thoroughly from the approach of enemies at either end. Having thus perfected its arrange-

ments, it again turns round so as to have its head upwards, when it rests from its labors in the interior of the passage until the following spring, when the mature larva sheds its skin and discloses the pupa. In this condition it remains for about two or three weeks, when the perfect beetle escapes. At first its body and wing-cases are soft and flabby, but in a few days they harden, when the beetle makes its way through the sawdust-like castings in the upper end of the passage, and with its powerful jaws cuts a smooth, round hole through the bark, from which it escapes.

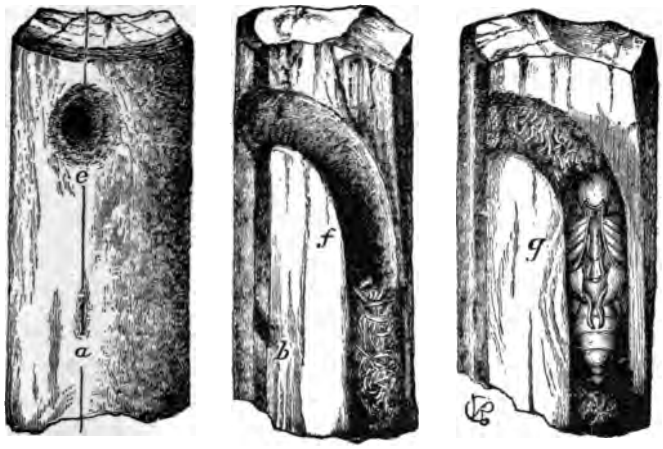


Fig. 134.—*Saperda candida*, Fab.—*a*, puncture in which egg is laid; *b*, same in section; *e*, hole from which beetle has emerged; *f*, same in section; *g*, pupa in its cell. After Riley.

"The larva, (Fig. 133), is of a whitish color, with a round head of chestnut-brown, polished and horny, and the jaws black. It also has a yellow horny looking spot on the first segment behind the head. It is without feet but moves about in its burrows by the alternate contraction and expansion of the segments of its body. When full grown it is over an inch in length. Fig. 134 shows the work of this borer.

"The color of the chrysalis is lighter than that of the larva, and it has transverse rows of minute spines on the back, and a few at the extremity of the body.

"Remedies: The young larva, as already stated, may often be detected by the discoloration of the bark. In such instances, if the outer dark-colored surface be scraped with a knife, late in August, or early in September, so as to expose the clear white bark underneath, the lurking enemy may be discovered and destroyed. Later they may be detected by their castings, which have been pushed out of the crevices of the bark, and have fallen in little heaps on the ground. When first discharged they look as if they had been forced through the barrels of a minute double-barreled gun, being arranged closely together in two parallel strings. Those which have burrowed deeper may sometimes be reached by a stout wire thrust into their holes, or by cutting through the bark at the upper end of the chamber, and pouring scalding water into the opening, so that it may soak through the castings and penetrate to the insect.

Fig. 135.—*Saperda cretata*, Newm.—After Division of Entomology, U. S. Department of Agriculture.

"Among the preventive measures, alkaline washes or solutions are probably the most efficient, since experiments have demonstrated that they are repulsive to the insect, and that the beetle will not lay her eggs on trees protected with such washes Soft soap reduced to the consistency of a thick paint by the addition of a strong solution of washing-soda in water, is perhaps as good a formula as can be suggested; this, if applied to the bark of a tree, especially about the base or collar, and also extended upwards towards the crotches, where the main branches have their origin, will cover the whole surface liable to attack; and

if applied during the morning of a warm day, will dry in a few hours, and form a tenacious coating, not easily dissolved by rain. The soap solution should be applied early in June, and a second time during the early part of July."

There are other species of *Saperda,* all injurious to trees. *S. obliqua* Say feeds in the wood of alder and hazel; *S. calcarata* Say is decidedly injurious to the poplar and cottonwood; *S. cretata* Newm. (Fig. 135), a beautiful beetle, very similar to *candida,* but with the white bands twice interrupted, also has similar habits, being found upon apple and thorns (*Crataegus* spec.); *S. vestida,* Say, *S. tridentata* Oliv., and *S. lateralis* Fab., occur upon a variety of forest trees, such as linden, poplar and others. *S. discoida,* Fab., is destructive to hickory; *S. concolor,* Lee, forms gall-like swellings on the younger trunks of the aspen; *S. puncticollis* Say is found in the stems of the poison ivy and oak.

THE RASPBERRY CANE-BORER.

(*Oberea bimaculata* Oliv.).

This beetle is similar to the species of *Saperda,* but it has a much longer and more narrow black body; the surface of the thorax and the fore part of the breast is pale-yellow, with two small black spots, absent in some specimens; or there is an additional small black spot on the posterior edge of the prothorax, just where the elytra join the same. The elytra are covered with coarse indentations, and are slightly notched at the ends. Fig. 136, Plate IV shows this beetle and its work.

Such, or similar beetles belonging to this genus, as the *O. flavipes* Hald., which is black with yellow legs, appear during the month of June, and after pairing the female deposits her eggs in the canes of the raspberry and blackberry in a very singular manner: "With her mandibles she girdles the young growing cane near the tip in two places, one ring being about an inch below the other, and between the rings the cane is pierced, and an egg thrust into its substance near the middle, its location

being indicated by a small dark-colored spot. The supply of sap being impeded or stopped, the tip of the cane above the upper ring soon begins to droop and wither, and shortly dies, when a touch will sever it at the point at which it has been girdled.

"The egg is long and narrow, of a yellow color, and quite large for the size of the insect, and, embedded in the moist substance of the cane, absorbs moisture and increases in size until in a few days a small white grub hatches from it. The larva as it escapes from the egg is about one-fourteenth of an inch long, with a yellow, smooth, glossy body, roughened at the sides, and clothed with very minute short hairs. The head is small and reddish-brown, and the anterior segments of the body are swollen; the larva is also footless. The young larva burrows down the center of the stem, consuming the pith, until full grown, which is usually about the end of August, when it is nearly an inch long and of a dull-yellow color, with a small, dark-brown head. By this time it has eaten its way a considerable distance down the cane, (Fig. 136, Plate IV), in which it remains during the winter, and where it changes to a pupa, the beetle escaping the following June, when it gains its liberty by gnawing a passage through. This borer injures the blackberry as well as the raspberry.

"The presence of these enemies is readily detected by the sudden drooping and withering of the tips of the canes. They begin to operate late in June, and continue their work for several weeks; hence by looking over the raspberry plantation occasionally at this season of the year and removing all the tops *down to the lowest ring*, so as to insure the removal of the egg, these insects may be easily kept under, for they are seldom numerous."

Other species of this genus in their larval stage make long cylindrical burrows in the twigs of the cottonwood and other related trees.

Longicorn beetles are generally favorites with collectors of insects, and are better known as beetles than as larvæ. But even people not collectors are familiar with some species, since these do not hide, but fully expose themselves on the plants they infest. This is especially true of certain longicorns that are found upon

the stems and leaves of our milkweeds, since they are of a brilliant red color, marked with a number of black spots upon the elytra and thorax. As larvæ they feed in the roots of a number of species of *Asclepia*.

FAMILY CHRYSOMELIDAE.

(Leaf-beetles or Chrysomelids).

The name "leaf-beetle" is well chosen, as these beetles feed both as larvæ and as adults upon the leaves of plants. The scientific name was selected for them from two Greek words, meaning *golden apple,* since most of these insects display brilliant and beautiful colors, and also because their form is usually round and oval. Such beetles are mostly short-bodied, more or less oval in outline; the head is very short, much narrower than the prothorax; the feelers are usually of moderate length, somewhat enlarged towards the tips, and set wide apart; the eyes are round and prominent; the legs are usually short and stout, and are furnished with tarsi of the same type as those of the preceding family, being also broad and cushioned beneath.

All our species in Minnesota can readily be distinguished from the longicorns, but such is not the case in other regions, where forms occur that are not easily placed in the families to which they belong. Most of our species are small, the well known "Colorado potato-beetle" being about the largest representative we have.

The larvæ are variously formed, but are mostly thick, broad, with well developed true legs. They live exposed upon leaves; some mine between the upper and lower cuticle of the leaves; still others cover themselves with their own excrement, while a few bore into the stems and roots of plants.

The eggs are usually deposited in small masses upon the leaves or stems of the plants upon which the larva feeds, and are frequently elongated and of a yellowish or orange color.

Leaf-beetles are very numerous, about six hundred species being found in North America alone. They are arranged in a

number of groups. Since all are vegetable feeders, they are more or less injurious, and sometimes, if they attack cultivated plants, they are very much so. Happily but few of them do so; many others feed upon worthless, even injurious plants, as weeds.

It is not possible to give a description of many of these beetles in this report, not even of the eleven tribes into which the family is divided. But to give some idea of their classification a few of the more common ones will be described, even if they are not destructive.

When we pick the flowers of the beautiful water lilies (*Nymphaea*), we are apt to find that their leaves are more or less perforated with small holes, and if we look a little more close-

Fig. 137.—*Donacia*—life history.—After Brehm.

ly we find the culprits near by. (Fig. 137.) They are very active and graceful beetles, usually of a metallic color; they are generally gregarious, flying about actively in the bright sunshine. They can run over the water, and being protected with a fine pubescence on the under surface of their bodies do not become wet.

Early in spring, about the time that the maples are in bloom, we find many beetles in such flowers that belong to this family; they are evidently of some good to the plants, for they carry the

ı from flower to flower, from tree to tree. They also occur
: flowers of the apple and plum. Their name is *Orsodacna*
Ahr.

Closely allied to them is a most beautiful beetle, but one
s decidedly injurious. It is as yet not found in Minnesota,
o doubt will reach us before long from the east.

THE ASPARAGUS BEETLE.

(*Crioceris asparagi* Linn.).

This is a small, red, yellow and black beetle, as seen in the il-
tion (Fig. 138). It gnaws holes in the heads of young

138.—*Crioceris asparagi*, Linn.—After Division of Entomology, U. S. De-
nt of Agriculture.

asparagus, and lays oval, blackish eggs upon them. The young larvæ, which are brown and slug-like grubs, also eat the young heads early in spring, but later a second brood of them feeds upon the full-grown plant. Wherever this insect occurs it causes great losses, and steps should at once be taken to destroy it.

A beetle of similar shape, the *Three-lined Lema*, (*Lema trilineata* Oliv.), but of a yellow color, with three black stripes on the wing-covers, is very common upon our "husk-tomatoes," or

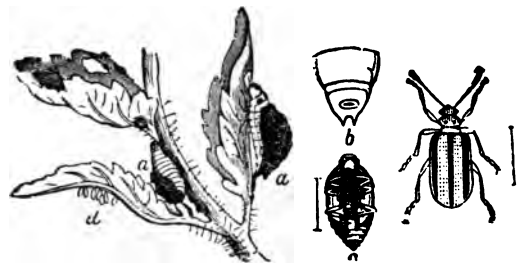


Fig. 139.—*Lema trilineata*, Oliv. After Riley.

"ground cherries," which are frequently entirely destroyed by them and their larvæ. These latter have the nasty habit of covering their backs with their own excrement. As they are also found injurious to the potato they should be killed with any of the arsenical poisons. We have two broods of this insect, the second brood hibernates in the ground as pupa. This species is illustrated in Fig. 139.

THE DOMINICAN CASE-BEARER.

(*Coscinoptera dominicana* Fab.).

This peculiar beetle is frequently found upon the leaves o[illegible] the plum, apple, rose, oak, and other plants. It is not especiall[illegible] injurious, but as it is frequently seen and has a peculiar life-hi[illegible] tory, it will be described in a few words. The name "dominican[illegible] has been chosen because it is neither ornate in color, being un[illegible] formly bluish-gray, nor prone to make itself conspicuous. It shown in all stages in Fig. 140. Its color is really black, wi[illegible] *t*

the exception of a yellowish brown labrum, but this color is so densely covered with a bluish or ash-gray pubescence as to become invisible; the under side is even more closely covered than the upper one. The eggs are attached to all sorts of plants by long stalks, and are covered by deep brown scales of excrement, most beautifully arranged in such a manner that the egg seems to be enclosed in a pine cone. The mother, in covering the egg, holds it horizontally between the tarsi, adding the stercoraceous

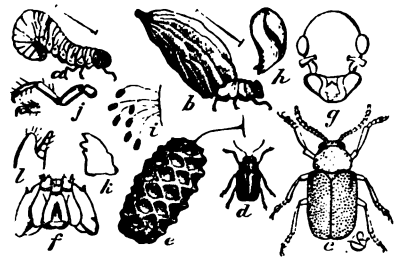


Fig. 140.—*Coscinoptera dominicana*, Fab.—After Riley.

covering in thin curved layers, which, in other related beetles, are pressed into various patterns by the anus. In many cases the female also possesses a little cavity at the tip of the venter, in which the egg is hidden if she is disturbed before the operation of covering it is completed. This egg hatches in about two weeks, and the young larva cuts itself loose from the shell or anchorage, and tumbling to the ground, has to shift for itself. The covering of the egg now forms a house for the young larva, which lives in it, gradually adding to the rim of the case, so that the house grows with its tenant. Inside it changes later to a pupa and perfect insect. The larva feeds upon dead leaves laying on the surface of the ground.

There is another beetle very common in our state, which so closely resembles the droppings of a caterpillar that but few expect it to be a living creature, especially as the beetle, if disturbed, drops to the ground and plays possum. The adult insect is a little oblong, cubical, roughly shagreened, metallic-green-

ish beetle, found very commonly upon the foliage of raspberries, blackberries, and that of other plants and trees. The larva of this beetle (*Chlamys plicata* Oliv.) is also a sac-bearer, as may be seen in the illustration (Fig. 141).

Other beetles, all not much longer than one-eighth of an inch, and belonging to the genera *Bassareus, Cryptocephalus,* and *Pachybrachys,* usually beautifully colored and marked with

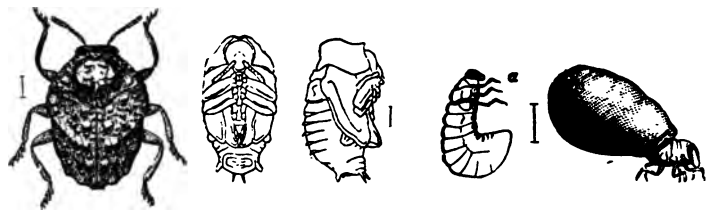


Fig. 141.—*Chlamys plicata,* Oliv.—After Marlatt (in part).

bright spots and lines, are also found upon the foliage of fruit-producing plants, but are not apt to cause any serious injury. The larvæ of most of them are not even known, but as far as discovered they are all sac-bearers, and live as such in or about the nests of ants.

THE GRAPE-VINE FIDIA.

(*Fidia longipes* Mels.).

Whenever this insect and some closely allied ones becomes at all numerous, it can cause considerable damage to the wild and cultivated grape. Some years ago nearly all the leaves of certain varieties of grape were destroyed by these beetles, which cut straight and elongated holes, into the leaves, about one-eighth of an inch in diameter, thus reducing them to mere shreds. The illustration, (Fig. 142), shows this insect. In the more southern states they sometimes literally swarm, and are in such cases perfectly able to destroy the entire foliage in even large vineyards.

Though very common, the beetle is not very often seen, as it is very watchful and shy, dropping to the ground upon the slightest disturbance; in falling it doubles up its legs, and thus rolls from the leaves, pretending to be dead. Knowing this habit large numbers can be captured by jarring them with a stick into an inverted umbrella. To make sure that they do not fly off again it is but necessary to line the inside of such an umbrella with some absorbent material, and soak this in kerosene oil. By doing so the oil will be kept in position, and any insect coming thoroughly in contact with it is doomed to die.

Fig. 142.—*Fidia longipes*, Mels.—After Saunders.

Fig. 144.—*Paria canella*—var. *6 notata* Say.—After Saunders.

Fig. 145.—*Paria canella*, Fab.—After Forbes.

The beetle is about a quarter of an inch long, is chestnut-brown, but so densely covered with short whitish hairs as to appear gray and hoary. It is found early in June, and only for a short time, after which it disappears.

THE GRAPE-ROOT WORM.

(*Fidia viticida* Walsh).

This beetle is very similar to the one described, and is a rather long-legged creature, covered with short hair, so that it appears gray. It is sometimes very injurious, especially in some of the Central States, as Ohio, but as it occurs over a large portion of our country it may cause injury almost anywhere and at

almost any time. This beetle also feeds, during June, upon the foliage of the grape, eating irregular holes into the upper surface. During this time the female also lays eggs on the trunk of the vine, or in any available crevice in the branches. In such places the eggs hatch, and the young larvæ drop to the ground, and entering it, make their way beneath it as well as they can. Eventually they reach the rootlets of the vines upon which they feed. The beetle is shown in its various stages in Fig. 143.

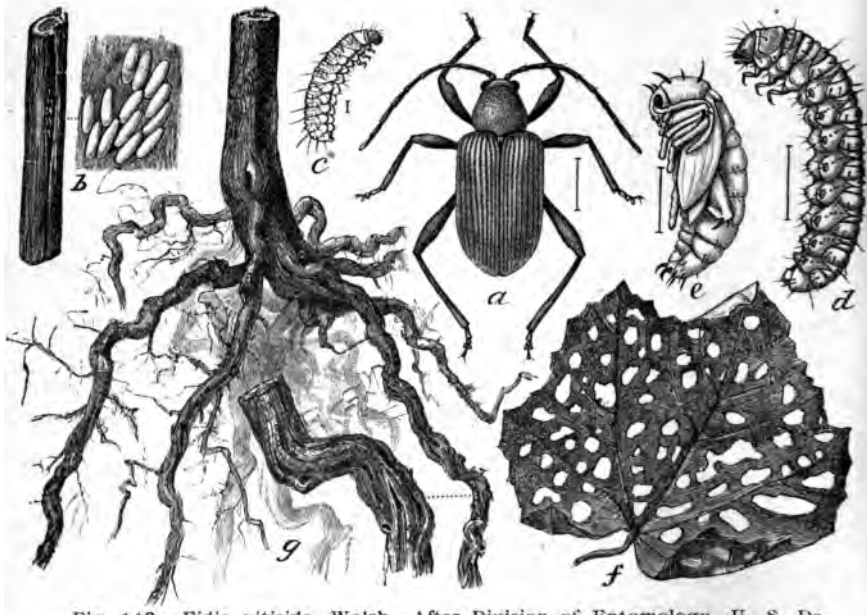


Fig. 143.—*Fidia viticida*, Walsh.—After Division of Entomology, U. S. Department of Agriculture.

So far remedial measures against the larva have not proven very satisfactory, but according to Prof. Smith, spraying with a strong arsenical mixture, using lime to avoid burning the foliage, will kill many of the beetles. Cultivating the ground so as to have a loose powdery top soil, without crevices leading to the roots, which should also be covered as deeply as possible, will prevent many of the larvæ from reaching their desired food.

There is still another beetle closely allied to the two species of *Fidia* just described. It is reddish-brown, a little smaller, more robust and is sometimes very common upon the foliage of the wild grapes. It is *Adoxus obscurus* Linn. Last year, late in July, it became very numerous upon some cultivated grapes, but could be readily gathered into an inverted umbrella. The beetles are very active and difficult to find when on the ground, the color of their bodies blending well with the surrounding particles of soil and refuse material.

One of the larger, and by far the most beautiful of all of our leaf-beetles is an insect very commonly found upon the two species of dog-bane growing in our state. Their form is characteristic of that of the following species, being elongated-oval. The beetle is entirely of a burnished metallic green color, with a darker bluish-green thorax. Various other tints, such as gold, brass, copper, appear if the insect is viewed in certain lights. Its name is a well selected one, being *Chrysochus auratus* Fab. It is frequently collected in large numbers by young people who arrange a number of butterflies in large glass cases in various patterns, as for instance in that of a flying eagle, and these brilliant beetles are frequently used to form the outlines of the picture.

THE STRAWBERRY ROOT-WORMS.

(*Paria canella* Fab. & others).

These very common beetles vary greatly in coloration and markings, and a number of varieties have been described. All are small, being about three-tenths of an inch long, polished, pale yellowish-brown, or darker, almost black, with two, four, or six black dots or spots upon the wing-covers. These spots are sometimes confluent, forming two longitudinal bands, or the black color may even cover the entire disk of the elytra; the under side is black. These stout beetles are very active in all their motions, moving about briskly when disturbed. They hibernate as beetles, and are very commonly found under rubbish along the edges of forests. From these places they frequently invade strawberry

beds, where they can become very destructive, and if at all numerous they devour the leaves of these plants with such avidity that they are soon riddled with holes, which of course materially injures the crop of berries. This is especially true of the Central States. In such cases the old beds should be plowed up and destroyed as soon as the crop has been picked, and new beds should be set out in fresh places, and for this purpose new plants are to be selected that were free from the attack of such root-worms. Wherever a two-year picking rotation is used, in which the old plants are immediately destroyed, this root-borer can not increase very greatly. Arsenical poisons are also very satisfactorily used to kill the adult when they are noticed upon the foliage, but it would be unsafe to do so when the fruit is already well set and large. Hellebore is also of use, and air-slaked lime dusted over the plants will, to some extent, lessen the trouble.

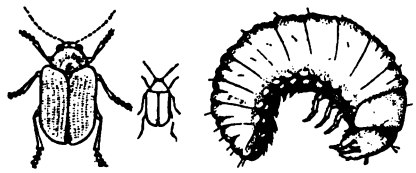


Fig. 146 —*Colas is flavida*, Say.—After Forbes (in part).

Fig. 148.—*Glyptoscelis cryptiscus*, Say.—After Saunders.

Prof. Forbes, who has studied, very closely the three species of strawberry root-borers, i. e., *Paria aterrima* Oliv., *Colaspis brunnea* Fab., and *Graphops pubescens* Mels., has also described the early stages of these beetles. He gives a full account of them in the "Thirteenth Report of the State Entomologist of Illinois." Like all his reports this one is of great value to the growers of all kinds of fruits.

By looking at the illustrations, (Fig. 145, 146, 147), which are reduced in size from the originals made by Prof. Forbes, we can perceive the structure of these beetles, and that of their earlier stages.

The larvæ are all small white grubs infesting the roots and crowns of the strawberry plants, eating the smaller roots, and penetrating and mining the interior of the crown and main root. These larvæ possess well developed legs, while the genuine "strawberry root-borer" described later has no legs at all. The following table is given in the report mentioned above, to show the difference between the three kinds of root-worms, all of which occur in our state, but still devote their attention more to the wild strawberries than to the cultivated ones.

Synopsis of larvae.

I. Mandibles bifid at tip.
   A. Inner edge of mandibles excavated before tip, anal segments shorter than preceding, ventral tubercles not prominent.....*Paria.*
   B. Inner edge of mandibles not excavated, anal segments more developed than preceding, ventral tubercles prominent, with long hairs.....*Colaspis.*

II. Mandibles entire at tip, inner edge excavated, anal segment short, ventral tubercles not prominent..*Graphops.*

Synopsis of pupae.

I. Anal hooks simple, incurved.....*Colaspis.*

II. Anal hooks recurved.
   A. Hooks short and stout, with strong erect tooth at upper side of base, and two long hairs on posterior margin .....*Graphops.*
   B. Hooks slighter, simple, or with slender hair at upper side of base, no hairs on margin.....*Paria.*

"The three beetles mentioned above may be easily distinguished, the *Colaspis* being usually of a pale clay-yellow, ranging to a yellowish brown, smooth but not shining, concolorous throughout, or occasionally with the head and thorax green; while *Paria* is shiny black above, varying to brown, with four black blotches upon the wing-covers, but always with pale legs (and

antennæ); and *Graphops* is purple or green, with a bronzed metallic luster, and covered with a gray pubescence, of which both other species are destitute."

As far as the adults are concerned they do not feed alone upon the strawberries, but are rather general feeders. *Colaspis brunnea* feeds by preference upon strawberry leaves early in the season, but later becomes very destructive by eating the foliage of the wild and cultivated grape-vine, hence is frequently named "Grape-vine Colaspis." It also occurs upon the blossoms of clover and willow, and upon the leaves of many kinds of trees, as it is frequently beaten into umbrellas used to catch insects.

Paria species are also general feeders; they do not alone injure the leaves of strawberry, but those of raspberry and crab apple as well. Many other leaves are eaten, and even the needles of the Juniper are to their taste.

Graphops prefers the strawberry plants, but is also very partial to the evening primrose, as large numbers of these beetles are found on this plant.

The life-histories of these insects as far as known are curiously different in respect to the times and periods of their development. The larva of *Colaspis* appears early in the season, and does its mischief chiefly in the months of April and May, the beetles beginning to emerge in June. That the eggs are laid in the preceding year is highly probable, in which case the species hibernates in the egg.

Paria, on the other hand, certainly passes the winter as an adult, doubtless laying its eggs in spring, and making its principal attacks upon the plants in June and July, the beetles emerging in the latter part of July, and early in August.

Graphops hibernates in the larval condition, pupates in the spring, and emerges in May and June. The eggs are probably laid in July, and the larvæ make their attack upon the plant in August and September, continuing it possibly to October as well.

As larvæ all three prefer the strawberry roots and crowns, and as far as known depend strictly upon this food. If at all numerous they kill the infested plants very soon, since as many

as fifteen or twenty grubs have been found about the roots of a single plant.

The remedies suggested for the *Paria* are applicable to all. Prof. Forbes makes the following very practicable suggestion: "To rid a new field of strawberry plants it would be wise to allow the new runners to set, in case the new plants should be suspected of containing such root-worms, and then to destroy the recently planted stools from which they sprang, leaving the field stocked only with new stools, formed since the plants were set out."

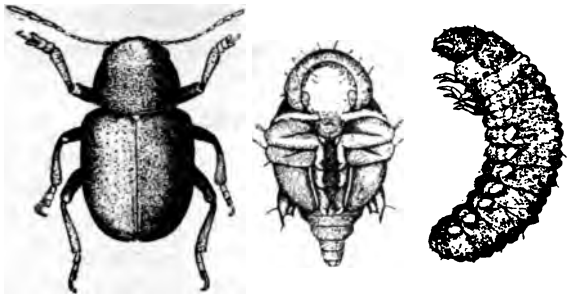


Fig. 147.—*Graphops pubescens*, Melsh,—After Forbes.

Fig. 149.—*Nodonota puncticollis*, Say.—After Division of Entomology, U. S. Department of Agriculture.

THE CLOAKED CHRYSOMELA.

(*Glyptoscelis crypticus* Say).

This is another beetle very similar to *Graphops pubescens*, but according to Prof. Saunders it devours the foliage of the apple-tree, as well as that of the oak. It is of a thick, cylindrical form, about one-third of an inch long, with its head sunk into the thorax, and the thorax narrower than the body. It is of a pale ash-gray color, entirely covered with short whitish hair. The closed wing-covers have a small notch at the top of their suture. At the junction of the wing-covers with the thorax there is a dusky spot. This insect is represented in Fig. 148.

THE PLUM LEAF-BEETLE.

(*Nodonota tristis* Ol.).

This oval beetle is of a shining, dark, metallic-blue, with legs and feelers yellow or chestnut brown; some specimens are bronzed, purplish, greenish, or even very dark brown. The thorax is densely punctuated with small dots. The damage they cause is not very great, although in the South they cause considerable injury by eating holes into the leaves of young plum trees; the peach and apple foliage is also to their taste, as well as that of the cherry, shad-berry, and choke-cherry, and Prof. Ashmead reports that they "gnaw little irregular holes into the blossoms and epidermis of the bolls of cotton, exposing them to the weather, and causing them to drop."

The beetles are not uncommon in Minnesota, especially upon apple trees, but they are not frequently seen, as they have the habit of hiding themselves in the folds of the leaves. The eggs are known, but not so the larvæ, which, very likely, possess the habits of related insects, i. e., are found among the roots.

A very similar beetle, (Fig. 149), the *Rose Leaf-beetle,* (*Nodonota puncticollis* Say), is also found upon the same kinds of plants, but seems to prefer the wild rose and blackberry; it also occurs on the young terminal leaves of willows, hence seems to be a general feeder. If at all numerous these beetles can be poisoned by means of the arsenites, and as they do not try to escape by flight they can be captured in large numbers by inverted umbrellas.

There are still other and similar small beetles which are more or less destructive to our fruit-producing plants, but none cause very serious losses, and then only at long intervals, when their number is increased by especially favorable climatic or other conditions.

Among the more typical leaf-beetles we have such forms as the well known *Colorado potato-beetle,* (*Doryphora* 10-*lineata* Say), originally a native of the Rocky Mountains, feeding in its old home on the sand-burr, (*Solanum rostratum*), a plant related

to the cultivated potato. As this beetle is not injurious to any of our fruit-producing plants, but confines its attention solely to such plants as the potato, egg-plants, tomato, ground-cherry and other members of the *Solanum* family, it is not necessary to describe it in detail, and only a picture of it is given to show how it differs from other leaf-feeding beetles. (Fig. 150 and 151, Plate I). This beetle commenced its migrations toward the east about the year 1859, reaching the Atlantic Coast about the year 1874. It moved from potato-field to potato-field, and as it had at first few enemies it increased most rapidly to destructive numbers. Now it has many foes among other insects, birds and mammals, and the farmers know quite well how to fight it by means of arsenical poisons. In fact the utility of Paris-green was first demonstrated by using it against this insect and its nasty looking larvæ.

Similarly shaped insects abound in Minnesota, but none are especially destructive, except, perhaps, the *Chrysomela exclama-*

Fig. 150.—*Doryphora 10 lineata*, Say.—After Brehm.

tionis Fab., a smaller yellowish-red beetle, marked with longitudinal black lines, the outer ones on each wing-cover being interrupted in such a manner as to look like an exclamation sign (!). The beetle is sometimes very numerous upon wild roses, destroying the flowers almost entirely. But as our wild roses in the prairies are decidedly a bad weed we should not complain even if it is a rose that suffers. *C. lunata* Fab., a peculairly colored light brown beetle, marked with darker brown, has similar food habits.

Several other members of the genus *Chrysomela* are very destructive to willows in our wind breaks. All can be fought by the same means, i. e., Paris-green or London-purple; these arsenites should be used at the rate of one pound in from seventy-five to one hundred gallons of water, and applied by machines, of which many very effective and cheap ones, especially constructed

Fig. 152.—*Lina tremulæ*, Fab.—After Brehm.

for this purpose, are in the market. But it should be recollected that the spraying should be done as soon as the beetles begin feeding in spring, so as to kill the adults before they have deposited their eggs. Our people usually wait until the damage caused by all kinds of insects becomes plainly visible, which is not a wise thing to do, as in such a case the application of the arsenites will simply check the trouble; the proper way to do is to nip the evil in the bud, and to do so an early warfare is absolutely necessary.

The very similar genus *Lina* also contains numerous very destructive beetles, which, however, devote all their attention to devouring the foliage of willows and poplars, in which they succeed only too well, as may be seen in some wind-breaks, which are defoliated year after year by these and some other insects, and to such an extent that they are as bare of green leaves in summer as during the winter. A timely application of arsenites would prevent this injury, which, repeated year after year, can result in but one way, the death of the infested plants. It seems as if many persons did not know the old proverb "an ounce of prevention is worth a pound of cure."

One species of *Lina* (*L. tremulae* Fab.), exceedingly abundant and injurious in the north, is illustrated in Fig. 152, and a still more destructive kind, the *L. scripta* Fab., in Fig. 153. It sometimes devours all the leaves of willows in our wind breaks.

Fig. 153.—Varieties of *Lina scripta*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

There is another small group of leaf-feeding beetles called the *Diabroticas*. They are rather slender and soft, with long feelers; their color is green or yellow, with black spots or lines. Prof. Smith, in his book already mentioned, gives the following account of them:

"The adults feed on leaves, flowers or pollen, but the larvæ, which are white and slender, usually feed in the roots and stems of plants. One of our most common forms, (*Diabrotica vittata* Fab.), is known as the "striped cucumber-beetle," and is yellow with black stripes on the wing-covers. It feeds on all kinds of cucurbit vines, and on many other plants as well; it does injury by eating into the stem of the young shoot at or below the surface, where it has a tendency to hide during the middle of the day. The larvæ, (Fig. 154), live in the main roots under ground, making short galleries, which, if numerous, weaken or even kill the plants. The beetles winter as adults. A free use of tobacco

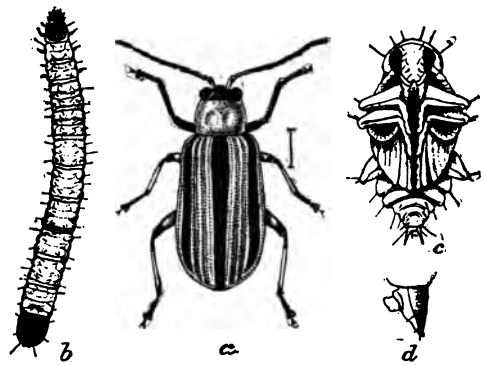


Fig. 154.—*Diabrotica vittata*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

dust around young vines or other injured plants is usually protective, though in some localities the farmers resort to " driving." They do this before the middle of the day, sowing air-slaked lime with the wind, and this seems to be sufficiently offensive to the winged insects to induce them to leave for fields to the leeward, where they of course become doubly injurious unless also driven off. Planting an excess of seed to distribute the injury is common practice, and so is starting the plants in baskets and setting them out when well established and able to resist injury.

"Melon and other cucurbit vines should always be plowed out, raked up, and destroyed as soon as possible after the crop is off, to destroy any larvæ that may then be in the roots."

It is also a common and very effective practice to cover young ants with a mosquito-netting, held in position by a slight frame.

Such beetles are not unfrequently found in the flowers of apple or plum, and they are there for no good purpose.

An allied and equally common species feeding upon a great variety of plants as an adult, is the *D. 12-punctata,* Oliv. or "12-spotted Diabrotica," (Fig. 155). This is somewhat larger than the preceding, with a more oval body, and has twelve black spots on the greenish-yellow wing-covers. The larva feeds on a variety of plants, and becomes injurious to the corn in the Southern States. There are two broods, the beetles wintering in the adult

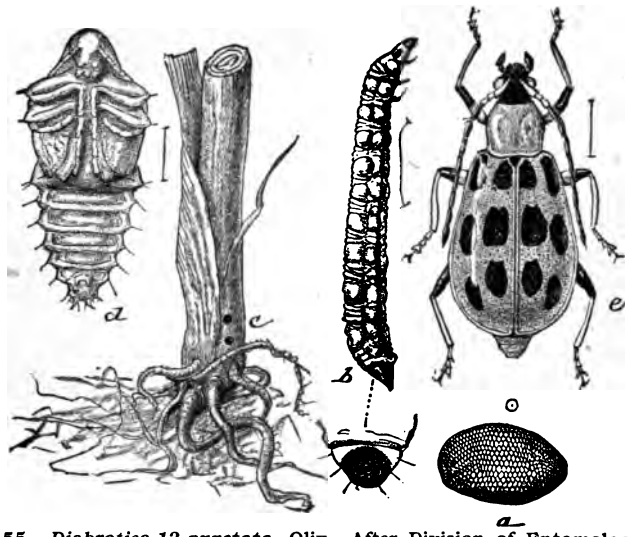


Fig. 155.—*Diabrotica 12 punctata*, Oliv.—After Division of Entomology, U. S. Department of Agriculture.

tage. No direct remedy is known, but good cultivation and a liberal application of stimulating fertilizers is advisable to enable the corn-plant to resist and outgrow attack. Clean culture is the greatest essential, and this of itself will do much to reduce injury.

In the Western and Central States a third species (Fig. 156) is found, the *"Corn-root Diabrotica,"* (*D. longicornis* Say),

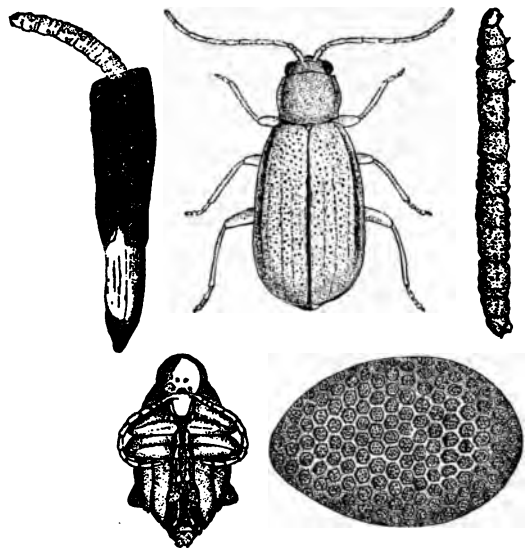


Fig. 156.—*Diabrotica longicornis*, Say.—After Forbes.

named so from its long feelers. Its larva is a very serious pest. As this species winters in the egg stage in corn-fields a simple rotation is all that is necessary to keep it in check. It is not found in Minnesota, at least no specimens have been seen or received, while the two species already described are very common, and the striped kind seems to be rapidly on the increase.

The genus *Galeruca*, as well as some closely allied other genera, contain a series of small oblong beetles, mostly of a dirty clay-yellow color, more or less spotted or marked with black. Some of these beetles are very destructive, not alone to shade-trees, but to fruit-trees as well.

THE CHERRY LEAF-BEETLE.

(*Adimonia femoralis* Melsh.).

In a number of states this beetle has caused considerable injury to the leaves of plum, cherry, and peach. Its natural food is the leaves of the native plum, into which it eats numerous holes. In Minnesota it is common enough in many localities, especially in

the burned region about Hinckley, where the "fire cherry," (*Prunus pennsylvania*), has taken full possession of the ground. It may be simply a question of time before it attacks the cultivated trees in our orchards as well.

The beetle is a small insect, measuring less than a quarter of an inch in length, and is of a bright red color, with feelers, eyes, and exterior portions of the legs black. It is densely covered with a coarse punctuation, the punctures being separated by distinct intervals; the surface is shiny. Such beetles are most abundant during June or early July, and again in September; those appearing in June seem to represent the hibernated generation, those appearing later are their progeny. As such beetles have been repeatedly found along the edges of woods early in April, there can be no doubt that they hibernate as perfect insects.

Fig. 157.—*Galeruca xanthomelæna*, Dalm.—After Division of Entomology, U. S. Department of Agriculture.

The egg is oval, bright straw-yellow, the surface deeply pitted with minute, rather irregular six-sided areas. The larva is about 5 mm. long, narrow, and tapering toward the end. According to Mr. Davis, it has the head, legs, pronotum and terminal plate black; on the back of each segment are two transverse rectangular dark spots, with two or more smaller ones on the sides of the larger two, and beneath them there is a longitudinal block on each segment. The venter of each abdominal segment is marked with five dark brown spots, the central one being largest. These larvæ also feed on the leaves of the cherry.

To show the general appearance of insects of this group of beetles, the *"Elm-leaf beetle"* (*Galeruca xanthomelaena* Schr.), is illustrated in Fig. 157. It is happily not found in Minnesota, at least none have been seen or received thus far; it is another of the many undesirable insects imported from Europe. It is greenish-yellow when fresh, with two black stripes on the wing-covers. The yellow, bottle-shaped eggs are laid in double rows on the under side of leaves and from them the yellow, black-spotted larvæ hatch, covered with little bristly tufts of hair. When full grown they crawl down the trunks to the ground, and there among the grass and rubbish on the surface they change to bright-yellow pupæ. These beetles and their larvæ are exceedingly injurious to the foliage of the elm trees, and in the eastern cities the authorities are forced to employ a large gang of men to protect and save the trees by spraying them with arsenical poisons.

FLEA-BEETLES.

This is another group of leaf-feeding beetles, of which many different kinds occur in our state. They are easily recognized by their hind legs, which possess very large and swollen thighs, enabling the insects to leap like fleas, hence the name flea-beetles (Fig. 158). But they differ from fleas in that they also possess wings as well, which are readily used.

One of the best known of such flea-beetles is the *"Sumach Flea-beetle"* (*Blepharida rhois* Forst.), which is exceedingly

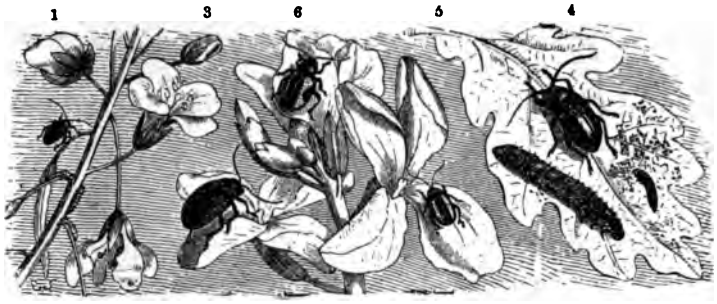


Fig. 158.—Flea beetles.—After Brehm.

numerous in our parks and along the edges of forests, or wherever the sumach grows. Here the filthy larvæ, filthy because they cover themselves with black and slimy pellets of their own excrement, frequently devour all the leaves of these showy bushes, and instead of being ornamental they become a decided eyesore to the

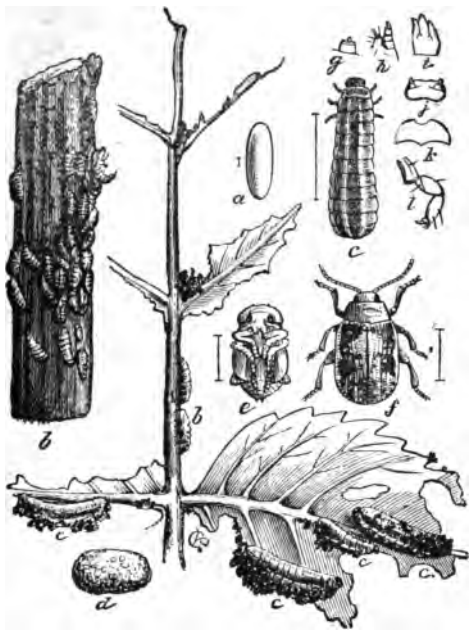


Fig. 159.—*Blepharida rhois*, Forst.—After Riley.

lover of plants and the admirer of well kept parks. This largest of our North American flea-beetles is shown in all stages in the illustration (Fig. 159). It is a rather convex beetle, differing greatly in this respect from other flea-beetles, which are usually very much flattened. The color of the beetle is a greenish-yellow,

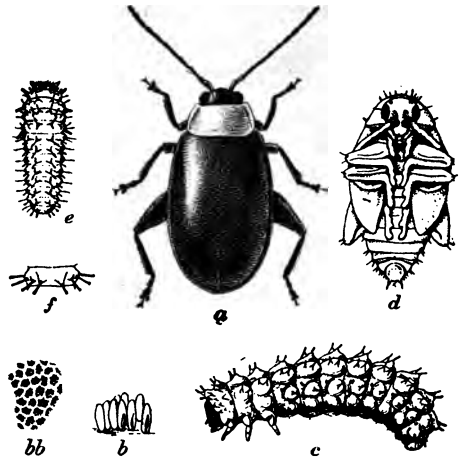


Fig. 161.—*Dionycha xanthomelæna*, Dalm.—After Division of Entomology, U. S. Department of Agriculture.

and the wing-covers are marked with dark brown lines and dots.

Our Minnesota fauna is rich in flea-beetles. Some quite large ones are found upon willows; they are usually yellow, with broad or narrow black longitudinal lines upon their wing-covers;

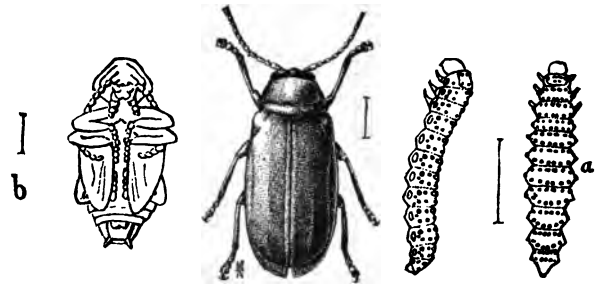


Fig. 162.—*Haltica bimarginata*, Say.—After Division of Entomology, U. S. Department of Agriculture.

the pro-thorax is in most cases ornamented with a number of dark spots arranged symmetrically. One kind of such beetles is frequently found squatting on the dry sidewalks very early in spring, as if enjoying the warm rays of the sun. If touched it disappears as if by magic, doing so by means of its powerful hind legs, which enable it to leap very long distances. One of these beetles is illustrated in Fig. 160; it is *D. xanthomelaena* Dalm.

A dark steel-blue species of the genus *Haltica, (H. bimarginata* Say), is sometimes exceedingly numerous and destructive to the willows growing upon the shores of our lakes, hence becomes to a certain degree injurious. It is shown in Fig. 162.

But not all flea-beetles are satisfied with such food, and to the great sorrow of fruit-growers some show a most decided love and preference for the foliage of fruit-producing plants.

THE GRAPE-VINE FLEA-BEETLE.

(*Haltica chalybea Ill.*).

This little beetle, very uncommon until the last season, has in some places become a very destructive pest to wild and cultivated grapes. It commences its operations very early in the season, and indicates its presence before long by eating the substance of the buds as soon as they begin to swell, thus destroying many bunches of grapes in the embryo. Prof. Saunders describes its life-history as follows:

"It goes on with this work for about a month, when it gradually disappears. Before leaving, however, the beetle provides for the continuance of its race by depositing little clusters of orange-colored eggs on the under side of the young vine leaves, which, in a few days, produce colonies of small, dark-brown larvæ, which feed on the upper side of the leaves, riddling them, and when numerous they devour the whole leaf except the larger veins, and sometimes entirely strip the vines of foliage. Fig. 163 represents the larvæ in various stages of growth at work on the vine, accompanied also by some of the beetles.

"In two or three weeks the larva attains its full growth, when it is a little more than three-tenths of an inch long, usually

of a light-brown color, sometimes dark, and occasionally paler and yellowish. The head is black, and there are six or eight shining black dots on each of the other segments of the body, each dot emitting a single brownish hair. The under surface is paler than the upper; its feet, six in number, are black, and there is a fleshy, orange-colored proleg on the terminal segment.

"When mature the larvæ leave the vines and descend to the ground, where they burrow under the earth, and form small, smooth, oval cells, within which they change to dark-yellowish

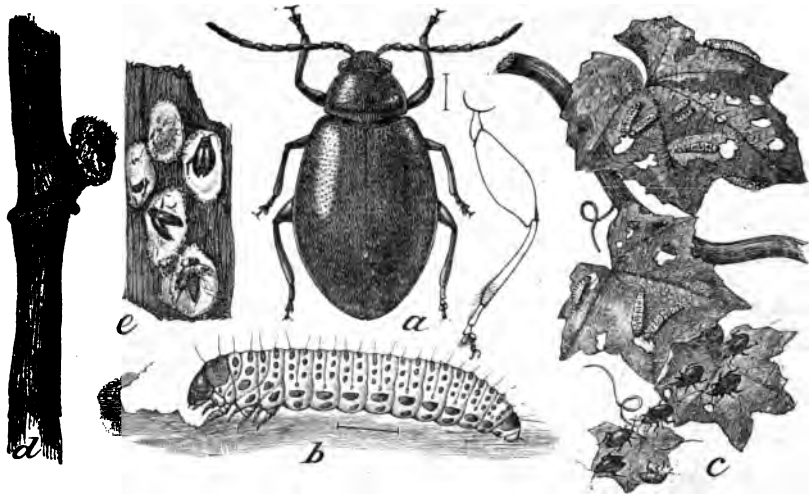


Fig. 163.—*Haltica chalybea*, Ill.—After Division of Entomology, U. S. Department of Agriculture.

pupæ. After remaining two or three weeks in this condition, the beetles issue from them, and the work of destruction goes on; but since they live altogether on leaves at this season of the year, of which there is an abundance, the injury done is much less than in the spring.

"The beetle is about three-twentieths of an inch long, and varies in color from a polished steel-blue to green, and occasionally to a purplish hue, with a transverse depression across the hinder part of the thorax. The under side is dark green, the antennæ and feet are brownish-black; the thighs are stout and ro-

bust, by means of which the insect is able to jump about very nimbly. One of the legs, detached from the body, is shown in Fig. 163. On the approach of winter the beetles retire to some suitable shelter, as under leaves, pieces of bark, or in the earth immediately around the roots of vines, where they remain inactive until the following spring. In addition to the grape-vine they feed on the Virginia Creeper, (*Ampelopsis quinquefolia*), and the alder, (*Alnus serrulata*), and sometimes eat the leaves of the plum tree.

"Remedies: To destroy the beetles it is recommended to strew air-slaked lime or unleached ashes around the infested vines in the autumn, removing and destroying all rubbish which might afford shelter. In the spring the canes and young foliage may be syringed with water in which a teaspoonful of Paris-green has been stirred to each gallon. Strong soap-suds have also been recommended, and are deserving of trial. On chilly mornings the beetles are comparatively sluggish and inactive, and may then be jarred from the vines on to sheets and collected and destroyed. These insects are much more abundant in some seasons than in others."

THE LESSER GRAPE-VINE FLEA-BEETLE.

(*Haltica ignita* Ill.).

This little beetle, not much more than half the size of the one described above, varies greatly in different portions of the Union, even in different parts of the same state. It is polished greenish-blue, dark blue, purplish-blue, copper-colored, or even brassy. All those found in Minnesota are dark blue, with a light tinge of purple. Their habits are identical with those of *H. chalybea,* hence it is not necessary to describe them. They were first noticed by Mr. J. W. Taylor, who resides near White Bear Lake, early in the spring of 1899, eating into the buds of wild grapes; soon afterwards they attacked his cultivated varieties, and later the foliage of the Virginia Creeper. Their work is shown in Fig. 164, Plate VI. After destroying the buds they continued

their work upon the fully expanded leaves, which were riddled in every conceivable manner to such an extent as to destroy them entirely. At least two generations did damage. The hibernating beetles commenced the work, and soon after their appearance numerous eggs were found among the woolly substance of the partly destroyed buds. The larvæ soon hatched and continued the work, and after passing the pupal stage in a small earthen cell in the ground, a new generation of beetles appeared, which did not disappear until the beginning of the warm weather in summer, evidently to pass the rest of the warm season and the winter in or near the ground.

It is somewhat difficult to ascertain the number of broods in this case, as some of the adults lived for a long time, and were surrounded by other beetles, their own progeny.

This species promises to become decidedly injurious, and wherever it is found should be fought with arsenites as soon as noticed.

This is especially important, and most successful in the spring when the culprits are still confining their attention to the buds. A very strong arsenical mixture, one pound to fifty gallons of water, with lime to prevent injury to the plant, has afforded good protection.

THE APPLE-TREE FLEA-BEETLE.

(*Haltica foliacea Lec.*).

This is another little flea-beetle about the size of *H. chalybea,* but slightly more elongated, and of a highly polished brassy-green color. The feelers are dull brownish-black beyond the three basal joints, which are obscured by short fine hairs; the feet are also dull brownish and pubescent.

This beetle is not common in Minnesota, having been found only in the southwestern part of the state, where it occurred rather abundantly feeding upon the evening primrose, the leaves of which were entirely riddled by it. It was found also upon similar plants growing near the shores of White Bear Lake, and Lake Minnetonka, as well as in Brookings, South Dakota, thus

showing that it may be much more generally distributed in our state than is suspected. In Missouri, Kansas, Nebraska, and Colorado it is a bad insect, especially so in nurseries, where it riddles the leaves of the apple with small irregular perforations.

Miss Mary E. Murtfeldt, whose work in entomological investigations is so well and favorably known, has published the following notes on the habits of this beetle in "Insect Life":

"I placed my beetles, received from Colorado, on fresh apple leaves and awaited developments. More than a month elapsed before I found eggs in the jar. On the 9th of July I found several clusters attached to the stems and bases of the midribs of the leaves. They are generally in twos and threes, ranged side by side. They are about 1 mm. in length, oblong rather than oval, and of a pale, dull orange color, somewhat translucent, and Prof. Popenoe, who has also obtained them, says that under a high magnifying power the shells are seen to be minutely granulated.

"By the 17th of July a number of larvæ had hatched. They are nearly cylindrical, of a dull black color, and rather more elongate in proportion to their diameter than the larvæ of *H. chalybea*. When grown they feed on the parenchyma of the leaf, indifferently on either surface, but later they gnaw holes in it similar to those made by the perfect beetle. The first molt took place in eight days, and two or three of the small larvæ perished in the process, being unable to entirely withdraw themselves from the outgrown skins. The second molt occurred one week later, and in this also one larva perished. During these periods there are no changes of color or maculation. August 2nd one larva had completed its growth, and as it was making its way into the earth, I put a stop to its further development by transferring it to the alcohol bottle. The following characters are noted: Length of mature larva from six to seven mm., diameter one and one-half mm.; form cylindrical, tapering somewhat posteriorly; general color varying from dull black to dark fuscous, piliferous plates inconspicuous, of the same shape, number and arrangements as those of *H. chalybea*, black in color, but slightly polished, each giving rise to from one to three minute hairs, head roundly

cordate, deep black, but not brilliantly polished, pro-legs well developed, faintly annulated at the joints with dingy white. The larvæ move about considerably, but in a slow and rather clumsy fashion, with the tip of the abdomen appressed to the surface of the leaf or stem to assist in keeping them in position.

"The pupa is enclosed in a frail earthen cocoon or cell, just beneath the surface of the ground. The pupal stage lasts only two weeks, when the adults make their appearance. The insect is also double brooded, the last generation passing the winter in the ground."

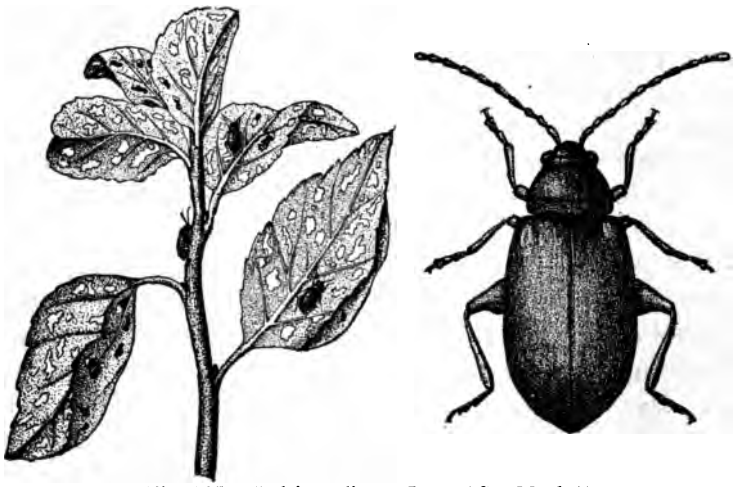


Fig. 165.—*Haltica foliacea*, Lec.—After Marlatt.

As this beetle, Fig. 165, is apt to become a serious enemy to our nurseries, their owners should be on the lookout to destroy it as soon as it is noticed. It seems to be changing its habits, deserting its normal food to become an enemy to cultivated plants.

As far as remedies are concerned, the experiments of Prof. Popenoe, of Miss Murtfeldt, and of Prof. Bruner are quoted: Beetles like the three species just described, can be successfully jarred into cloth collecting frames, and if these are saturated with kerosene, the beetles striking them will not be able to fly away, but will perish.

There are still other and still smaller flea-beetles which riddle the leaves of apple trees with small holes, but the damage is slight, since such insects as a general rule prefer other plants for food.

THE SMALL WILLOW FLEA-BEETLE, (*Crepidodera Helxines* Linn.), a very common insect, eating the foliage of most of our narrow-leaved willows, has been repeatedly found towards the end of June engaged in doing similar work on that of the apple. It is one of the most variable beetles we have, at least so far as colors are concerned, and numerous varieties have been made on that account. It is usually, however, of metallic green, blue, coppery or golden. As a general rule all leaf-feeding beetles distinguished by metallic colors vary greatly in this respect. This beetle is still smaller than *H. ignita* mentioned before. *C. rufipes* Linn., illustrated in Fig. 166, gives a good idea of how such insects look.

Fig. 166.—*Crepidodera rufipes*, Linn.—After Division of Entomology, U. S. Department of Agriculture.

Fig. 167.—*Epitrix cucumeris*, Harr.—After Division of Entomology, U. S. Department of Agriculture.

A still smaller flea-beetle, the *Cucumber Flea-beetle, (Epitrix cucumeris* Harr.), and the closely allied *E. fuscula* Crotch, are also found eating holes in the leaves of apples. As the former one is a very destructive beetle to all plants belonging to the botanical order *Solanaceae,* it is illustrated in Fig. 167. The name "Cucumber Beetle" is surely a misnomer, since notwithstanding its omnivorous habits it is practically confined to the above order of plants. The beetles are chiefly destructive to tomatoes, potatoes,

tobacco, egg-plants, and pepper, and can cause considerable mischief to the young and tender plants, into which they eat numerous holes.

The beetle is very small, black, covered with rather thick hairs; the feelers and legs are reddish-brown. It is a very active being, and one very difficult to capture, being as agile as a healthy and vigorous flea. In the larval stage it feeds chiefly in the roots of the tomato.

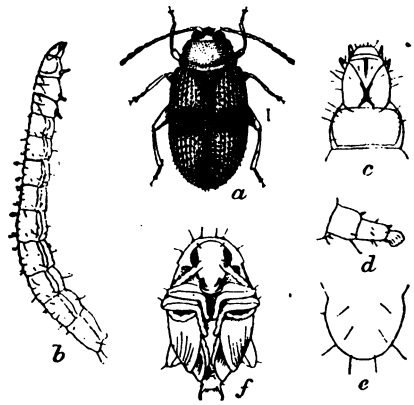


Fig. 168.—*Epitrix parvula*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

E. fuscula Cr., has once been very destructive in hot-house frames, in which it killed numerous small egg-plants; *E. parvula* Fab., so destructive to tobacco in the southern states, is shown in Fig. 168.

As far as remedies are concerned, Paris-green and London-purple are satisfactory remedies, and it has also been observed that the Bordeaux mixture, used against certain diseases of plants, when liberally used, acts as a deterrent, and thus serves a double purpose. If poisons can not be used a decoction of tobacco is of great benefit, at least if we have to use it only on a small scale.

THE RED-HEADED SYSTENA.

(*Systena frontalis* Fab.).

This common flea-beetle has repeatedly caused injury to the grape-vines by eating the green tissues on the upper sides of the leaves, which in consequence discolor and wither. Like the other flea-beetles it possesses enormous leaping powers, and as it is rather large and very agile, it is no easy matter to capture it. It is about one-sixth of an inch long, with densely, but very finely punctured thorax and wing-covers. The head is reddish-yellow above, especially in front and between the eyes; the long feelers are also reddish, with black basal joints; the underside is brownish-black. Equally common is *S. hudsonias* Fab., which is entirely black, with dark rusty-brown feelers and legs.

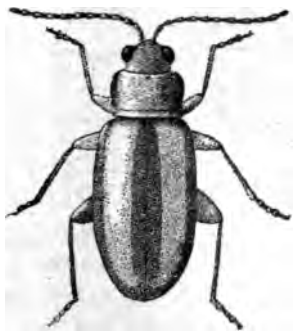


Fig. 169.—*Systena tæniata*, Say.—After Forbes.

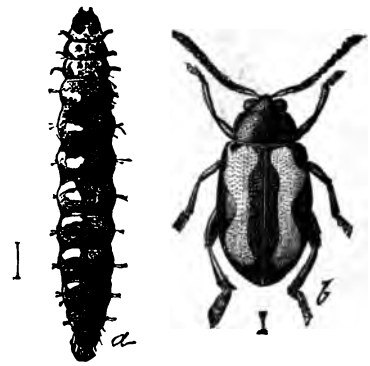


Fig. 170.—*Phyllotreta vittata*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

Another species of *Systena*, illustrated in Fig. 169, is decidedly injurious to the young plants of the sugar-beets. It is called the *"pale-striped flea-beetle"* (*S. taeniata* Say), and is here illustrated to show the shape of insects of this kind.

Among the large numbers of injurious flea-beetles at least one other should be mentioned, as it is frequently received as being very destructive to a number of young plants, but chiefly to plants belonging to the *Cruciferae*, as cabbage, radish, mustard, and oth-

ers. The "Wavy-striped flea-beetle," (*Phyllotreta vittata* Fab.), is illustrated in Fig. 170. It is a minute, shiny black insect, with a distinct yellow stripe through the middle of each elytron. The larvæ make mines into the tissues of the plants mentioned above. As a remedy it is important to keep down all cruciferous weeds, in other words to give the land a clean culture, and to remove the remnants of the crop as soon as possible and to destroy them. The adult becomes even more injurious by eating little pits into the thicker leaves, and minute holes into the thinner-leaved plants they infest; in such cases the use of arsenites or of kerosene-emulsion is of great benefit.

According to Prof. Saunders this beetle is also sometimes found to eat the leaves of strawberry plants.

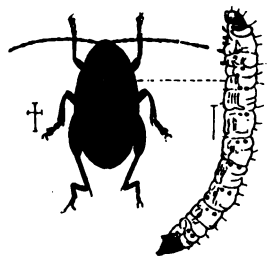


Fig. 170½.—*Psylliodes* species.—After Brehm.

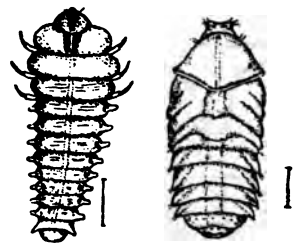


Fig. 171.—*Odontota dorsalis*, Thunb.; larva and pupa.—After Hopkins.

Numerous other flea-beetles belonging to the genus Psylliodes occur in Minnesota; one of which is shown in Fig. 170 ½.

A small number of very curiously shaped beetles follow the flea-beetles in the classification of beetles usually adopted. They are wedge-shaped beetles, or *Hispidae*, in which the antennæ are thickened, and the elytra broadened at the tip, where they terminate rather abruptly. In most of these brightly colored beetles the body is much roughened by deep furrows and pits. These and the tortoise beetles, which follow next, also differ from other leaf-feeding beetles in having the fore part of the head prominent, so that the mouth-organs are situated on the underside.

The larvæ of *Hispidae* are leaf-miners; the eggs are covered with a little mass of excrement, and are laid singly. None of the beetles are very injurious, with perhaps the exception of the "locust-beetle," (*Odontota dorsalis* Thunb.), which is orange in color, with a broad black stripe along the suture of each elytron. Sometimes this species is so abundant early in summer, on the leaves of the locust, as to cause considerable injury, but as the beetles feed exposed they succumb readily to an application of the arsenites. The larva and pupa of this beetle are shown in Fig. 171.

According to Prof. Comstock the larva of *O. rubra* Web., a beetle from one-eighth to one-fifth of an inch long, of a reddish color, with the elevated portions of the elytra more or less spotted with black, mines in the leaves of apple, forming a blotch-mine. The transformations are undergone within this mine, which is also formed in great numbers on the leaves of linden or basswood.

THE ROSY HISPA.

(*Odontota nervosa* Panz.).

This is a much smaller species, flat, rough, coarsely punctuated, the wing-covers forming an oblong square, as shown in Fig. 172. There are three smooth, raised longitudinal lines, spotted with red, on each of them, while the spaces between them are deeply pitted with double rows of dots. The head is small, the feelers short, thickened towards the end, and the thorax is rough above, and striped with deep red on each side. The under side of the body is usually darker in color, sometimes blackish. This species varies a good deal, not alone in size, but also in color and markings, and formerly a number of species had been made of it, one of which, (*O. inaequalis* Web.) is very dark, almost uniformly brownish-black, with some lighter spots and lines. The beetle is found from the latter part of May until the middle of June, and deposits its eggs on the leaves of the apple tree.

According to Prof. Saunders, "they are small and rough, and of a blackish color, fastened to the surface of the leaves sometimes singly, and sometimes in clusters of four or five.

"The larvæ when hatched, eat their way into the interior of the leaf, where they feed upon its green pulpy substance, leaving the skin above and below entire, which soon turns brown and dry, forming a blister-like spot. The larva, when full-grown, which is generally during the month of July, is about one-fifth of an inch long, oblong in form, rather broader before than behind, flattened, soft, and of a yellowish-white color, with the head and neck blackish and of a horny consistence. Each of the three anterior segments has a pair of legs; the other segments are provided with small fleshy warts at the sides, and transverse rows of little rasp-like points above and beneath.

"The larva changes to a pupa within the leaf, from which, in about a week, the perfect insect escapes. Within these blister-like spots the larva, pupa, or freshly transformed beetle may often be found."

Fig. 172.—*Odontota nervosa*, Panz.—After Harris.

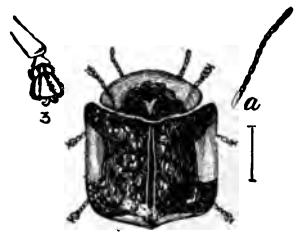


Fig. 173.—*Coptocycla clavata*, Fab.—After Riley.

This interesting beetle is quite common in Minnesota, and occurs also in regions where no apples grow, hence it must be able to make mines in other plants as well. The adult beetle hibernates, and is frequently found among dead leaves and rubbish covering the ground along the edges of forests.

THE TORTOISE-BEETLES.

These remarkable beetles contain species that are among the most beautiful of all insects, being green, golden, or iridescent. Some in the tropics are so brilliant that at one time it was stylish to use them for jewelry. Although not injurious to fruit-produc-

ing plants they are so curious, and so often mailed as "gold-bugs" to the entomologist, that a few words about them may not be amiss.

In these beetles the ovate and almost quadrate body is flattened below and convex above; the head is nearly or quite concealed beneath the prothorax and the margins of the latter and of the elytra are broadly expanded, in some cases forming an almost circular outline, and in this way resembling the shell of a tortoise. This resemblance is heightened in at least one case, (*Coptocycla clavata* Fab.), by four dark projections of the central dark color of the wing-covers, which marks look like the broad legs of a turtle (Fig. 173). In another case (*C. guttata* Oliv.), only the front legs of a turtle are painted upon the frontal sides of the elytra.

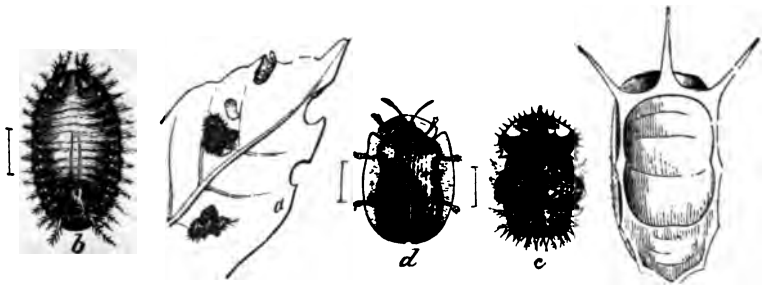


Fig. 174.—*Coptocycla bicolor*, Fab.—After Riley.

As already mentioned these beetles, when happy, are of brilliant colors, sometimes ornamented with black spots or longitudinal lines. One of our most common species, the *Cassida bicolor* Fab., (Fig. 174), so destructive to morning-glories and sweet-potatoes, is, during its wedding season, like a drop of burnished gold, which towards night is apt to fade to a peculiar pearly luster. Unfortunately such colors are not "fast," but disappear after the death of the insect. It is even claimed that the bright colors of these insects are dependent upon the emotions of the beetles.

Although the beetles are very beautiful, the larvæ are as nasty; they are flat, with long spines along the margins, and in addition they possess a forked appendage at the posterior end, which serves a very filthy purpose. It is bent forward over the back, and to it are attached the cast-off skins of the larva and also its excrement. The fork carrying such material is borne like an umbrella. In New Jersey, Maryland, and Virginia, where these insects abound in the sweet-potato fields, the larvæ have received the name "peddlers," since they carry a "pack." When ready to change to a pupa the larva fastens the posterior end of its body to the underside of a leaf, and now the skin splits open, and is forced back, exposing a pupa, which soon gives forth a beetle. Wherever such beetles are numerous the young plants of the sweet-potato should be dipped into arsenate of lead before they are set out. The solution should be fifteen ounces to fifty gallons of water.

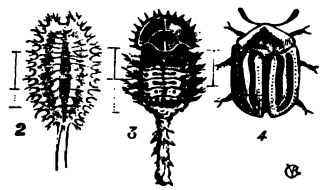


Fig. 175.—*Cassida bivittata*. Say.—After Riley.

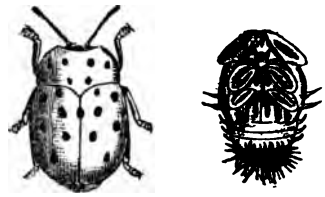


Fig. 176.—*Chelymorpha argus*, Licht.—After Packard.

In Minnesota we have a number of such tortoise beetles, some very large, and also some that are found on other plants than those belonging to the family of *Convolvulaceae*, as the nettle and sunflower. *Cassida bivittata* Say (Fig. 175) frequently destroys the foliage of the beautiful morning-glory, and the much larger *Chelymorpha argus* Licht. (Fig. 176) is frequently found on the raspberry.

FAMILY BRUCHIDAE.

(*Pea-weevil family*).

These well known beetles, so destructive to many kinds of stored seeds of leguminous plants, as peas and beans, are not

injurious to any fruit-producing plants. They agree with the leaf-beetles in general structure, but their small head is prolonged into a broad beak and the wing-covers are rather short, not covering the tip of the abdomen. As an example of these beetles the *Bean-weevil* (*Bruchus rufimanus* Sch.), and the *Pea-weevil* (*B. pisi* Linn), are illustrated in Fig. 177. This pest can be controlled, even when still enclosed in the seed, by means of bisulphide of

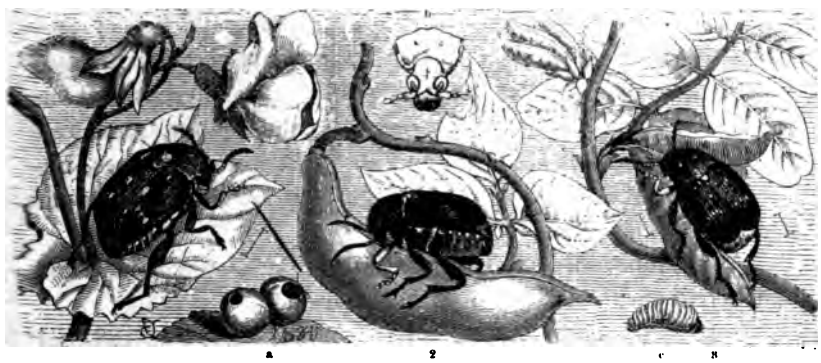


Fig. 177.—*Bruchus rufimanus*, Sch., and *B. pisi*, Linn. After Brehm.

carbon, the seeds being kept in a tight receptacle for this purpose. It should be the rule of every farmer to plant only sound seeds, and not to throw away any "buggy" peas, but to destroy the insects in them by boiling, when both peas and weevils can be fed to animals.

2. HETEROMERA. (Different Joints).

As already mentioned we find the chief peculiarity of the beetles in this group in the feet, the front and middle pairs of which are five-jointed, and the hind pair four-jointed; the joints of the tarsi are not cushioned beneath, as are those of the leaf-beetles. Many peculiar insects belong to this division, not alone peculiar on account of their shape, but also on account of their peculiar development, which has one or two seemingly retrograde stages in some species having parasitic habits.

FAMILY TENEBRIONIDAE.

(*Darkling Beetles*).

Nearly all the members of this family are of a uniform black or brown color, although some are gray, and a few are marked with bright colors. There is no uniformity in appearance, but in most cases the feelers are more or less bead-like or moniliform. They vary very considerably in size and form of the body, which is firm, and not soft as in the case of the blister-beetles mentioned later. Darkling-beetles are most numerous in dry and warm regions, but we also possess a fair representation in Minnesota, and some of them are altogether too numerous and injurious. Nearly all feed upon dry vegetable matter, some few on partly decomposed matter, and still others under stones, under bark of trees, and on fungi. But few are injurious to our fruit-producing plants.

As examples of such beetles a few of the more common and destructive ones will be given and illustrated.

THE MEAL-BEETLE, (*Tenebrio molitor* Linn.), Fig. 178, is a very common insect in our mills, stables, grocery-stores, pan-

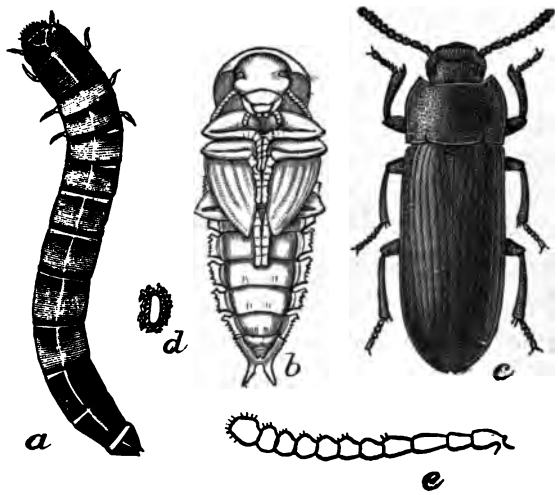


Fig. 178.—*Tenebrio molitor*, Linn.—After Division of Entomology, U. S. Department of Agriculture.

tries, in fact in all dark places where flour and meal is kept for a long time. These insects cause no serious injury, but are far from pleasant to have around. Their larvæ, best known by the name of "meal-worms," are sometimes bred purposely by bird-fanciers as winter food for insectivorous singing-birds; they are raised in immense numbers in warm boxes partly filled with bran, and in such places they undergo all their metamorphoses.

The beetles themselves are brownish, flattened, with a square thorax and deeply ridged wing-covers. The larva is a cylindrical, hard-shelled worm, usually of a polished waxy yellowish-brown

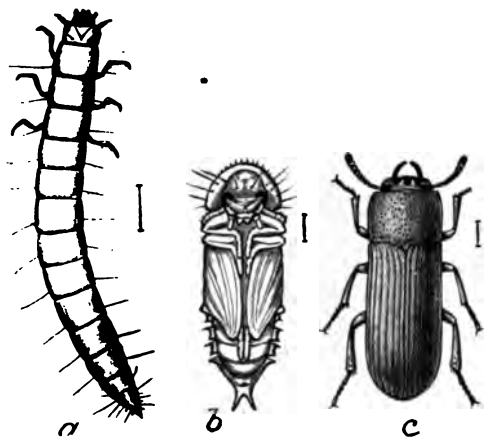


Fig. 179.—*Echocerus maxillosus*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

color, and terminates in a two-pointed posterior segment; it resembles the larva of the wire-worm in many ways, but is very much stouter.

A dark, almost black and more opaque beetle is the *T. obscurus* Fab., which is found in similar locations. Both are pests of granaries and mills, and are found in almost every region of the globe, being carried there by commerce.

A much smaller species, the *Echocerus maxillosus* Fab., is shown in Fig. 179. It is of a brown color, and further south is equally as much at home in old and neglected flour.

Cleanliness is one of the best remedies against such nocturnal insects. In extreme cases the fumes of bisulphide of carbon should be employed to kill them. Many of these and similar beetles have become very numerous in our houses since the introduction of prepared breakfast foods; the spaces behind the patent flour bins in pantries are also excellent breeding places for such insects, as there they are not as often disturbed as they ought to be.

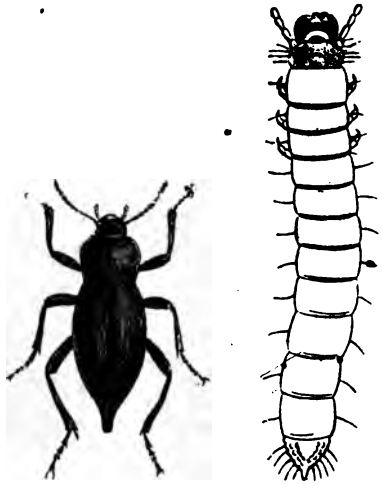


Fig. 180.—*Blaps mortisaga*, Linn., and larva. After Brehm.

Fig. 180 shows a common beetle belonging to this family; it is *Blaps mortisaga,* and is found in Europe, like the meal-bug, in barns, stables and cellars. Our western plains, especially in the warmer regions, abound in similar beetles; they are found in large numbers beneath dry dung, and some of them are very peculiar beings, having their wing-covers soldered together, since they possess only rudimentary true wings or none at all. Fig. 181, (Plate I) shows a very peculiar insect, black and white in color; it is *Zopherus Haldemani* Salle.

One of the most peculiar beetles belonging to this family is frequently received by the entomologist as a great rarity, simply

because the males have a pair of enormously large horns on the pro-thorax. This beetle, (*Boletotherus bifurcus* Fab.), possesses a very rough surface on the body and wing-covers, and is of a dirty brownish color. It feeds upon the large toadstools, (*Polyporus*), so common on the sides of dead and dying trees. Fig. 182, Plate II, shows both sexes of this remarkable insect.

A large number of small families of beetles follow, but none of the insects contained in them are of any great economic importance.

FAMILY MORDELLIDAE.

The beetles in this family are all small, some very small. Some are black, others are variegated, but all are covered with a silky pubescence. Such beetles are found in immense numbers during the early summer, in many kinds of flowers, in which they feed upon the pollen. In doing so they are of some importance in cross-fertilization.

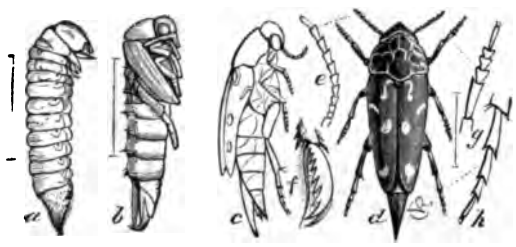


Fig. 183.—*Mordella 8-punctata*, Fab.—After Riley.

As may be seen in the illustration, (Fig. 183), which shows *Mordella 8-punctata* Fab., they have a very arched body, the head is bent down, and the abdomen is usually prolonged into a slender point. They are very active, flying readily, but they usually try to escape by the most intricate contortions, which make it almost impossible to secure them, and they usually drop to the ground and are lost. Their larvæ live in rotten wood and in the pith of plants.

FAMILY MELOIDAE.

(*Blister-beetles*).

Perhaps the most interesting and economically the most important among the *Heteromera* are the "Blister-beetles," which have received this very appropriate name because they can raise blisters on the human skin, caused by a substance "cantharidin" found to a greater or less extent in nearly all members of this family. To utilize them for this purpose they are dried and pulverized, and the powder thus obtained is made into a paste, which applied to the skin by physicians causes local inflammation and a blister. Nearly all our common species can be utilized for this purpose, but the kinds generally used come from Spain and other European countries, hence are called "Spanish-fly," (Fig. 184).

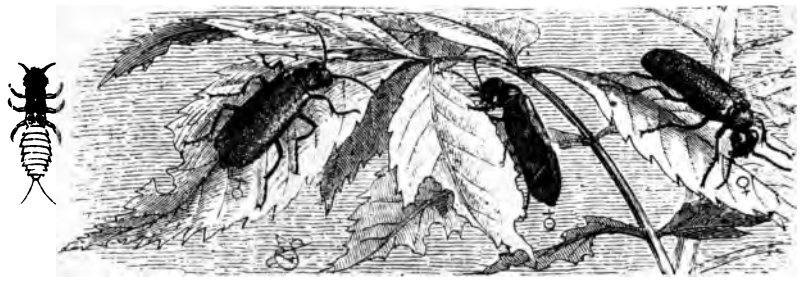


Fig. 184.—Spanish flies. After Brehm.

All the beetles belonging here are soft-bodied and of medium or large size; their head is broad, vertical, abruptly narrowed into a neck; the pro-thorax is narrow and cylindrical, and is narrower than the wing-covers, which extend well down the sides; the legs are long and slender, and the feelers are in some cases knotted in the males. Many of the species are brightly colored and banded, some are metallic bronze or copper, others are uniformly gray, black or brown, with black longitudinal stripes. All are leaf-feeders and are found in flowers.

One of our most common species is black, and occurs in large numbers on the flowers of the golden rod. A number of species of this family are very destructive to the leaves of the potato, bean, aster, rose and other plants, and one at least is decidedly injurious to the flowers of the cultivated shad-berry. This large beetle, (*Pomphopoea aenea* Say), called the *Pear-tree Blister-beetle*, is also fond of the leaves of apples. (Fig. 185).

The metamorphoses of blister-beetles are remarkable, as they do not alone undergo wonderful changes in form, but the number of such changes is greater than usual with beetles. The adult deposits a large number of yellowish eggs in the ground, which hatch into very active long-legged larvæ, that run about in search of food consisting of the eggs of locusts and of some solitary bees. Eating the eggs of locusts is a very good habit, hence the blister-beetles are decidedly beneficial in their larval stage, and it is a well known fact that in a year following locust troubles blister-beetles become very numerous. In other cases the eggs are either laid on a plant or on the ground, and similar long-legged larvæ are hatched, which run about the flowers until a proper kind of bee comes along, to the hairy clothing of which they fasten themselves, and in this way are carried to the nest of the bee, not simply stealing the ride, however, but adding injury to insult, for after quitting the unsuspecting host it devours the egg or young larva and later completes its own transformation, meanwhile feeding upon the accumulated stores, the rightful owner of which it has killed.

These young larvæ of blister-beetles are active little creatures, with long legs, prominent jaws, large heads, and are known as "triungulins."

The most common of our blister-beetles are the uniformly gray *Macrobasis unicolor* Kirby, (Fig. 151, Plate II), and the black *Epicauta pennsylvanica* DeG. As a description of both is given in the first annual report it is not necessary to repeat it here.

If these insects, as well as similar ones, should become very destructive, they can be killed by a thorough application of one of the arsenites, adding some milk of lime to make the poison

FAMILY MELOIDAE.

(*Blister-beetles*).

Perhaps the most interesting and economically the most important among the *Heteromera* are the "Blister-beetles," which have received this very appropriate name because they can raise blisters on the human skin, caused by a substance "cantharidin" found to a greater or less extent in nearly all members of this family. To utilize them for this purpose they are dried and pulverized, and the powder thus obtained is made into a paste, which applied to the skin by physicians causes local inflammation and a blister. Nearly all our common species can be utilized for this purpose, but the kinds generally used come from Spain and other European countries, hence are called "Spanish-fly," (Fig. 184).

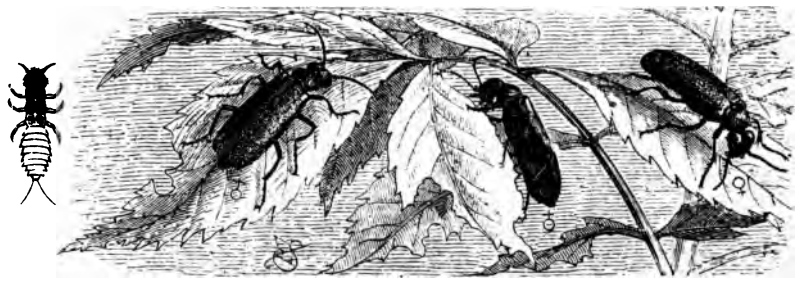


Fig. 184.—Spanish flies. After Brehm.

All the beetles belonging here are soft-bodied and of medium or large size; their head is broad, vertical, abruptly narrowed into a neck; the pro-thorax is narrow and cylindrical, and is narrower than the wing-covers, which extend well down the sides; the legs are long and slender, and the feelers are in some cases knotted in the males. Many of the species are brightly colored and banded, some are metallic bronze or copper, others are uniformly gray, black or brown, with black longitudinal stripes. All are leaf-feeders and are found in flowers.

shorter. It is either broad or thin, short or long, straight or curved. The small sharp jaws are situated at the end of the beak or *rostrum;* the labrum and palpi are small or wanting; the slender feelers arise from the sides of the beak, and are elbowed in the middle, ending in a knob or club; the rostrum is often grooved at the sides for the reception of the feelers, and the eyes are small and round. But the most distinctive character is the absence of the gula, there being but a single gular suture, (Fig. 187), and the epimera of the pro-thorax meet on the middle line behind the prosternum. The body is compact, and frequently wedge-shaped, and not uncommonly has a ridged and pitted surface, or is raised into tubercles. The tarsi are four-jointed, each joint strongly bilobed and cushioned beneath. None of our species are of more than medium size, and most of them are very small.

Nearly all our northern species of snout-beetles, when disturbed, feign death, and do so most skillfully and persistently; the feelers disappear into the grooves in the beak, and the latter is bent under in many cases, close to the body, as are also the legs, and the beetle drops to the ground, closely resembling a bit of twig, a bud, or a seed, and thus escapes detection. In the tropics, however, many of such beetles are very active, and take to their wings almost as readily and easily as the tiger-beetles.

Many of the larvæ of such insects live in fruit, seeds, nuts; others devour the substance inside the stems of plants, and still others subsist on wood. Larvæ of snout-beetles are usually more or less curved, pale, and much wrinkled, as may be seen in the following illustrations, which show their structure as well as that of the adults and pupæ.

FAMILY RHYNCHITIDAE.

This family includes small beetles in which the elytral fold is very feeble, the labrum wanting, and in which the mandibles are toothed both on the outer and inner side. The mandibles can be widely spread apart; when closed the outer tooth at the end

stick, and this should be carried into effect as soon as they are noticed. In some cases they can also be driven to a layer of straw, which is then burned. But as the larvæ feed upon such dangerous material as the eggs of locusts, it is in many cases better not to kill the adults.

Of the larger and brighter species one of the most common is a rather beautiful beetle, the *Cantharis Nuttalli* Say; it measures over an inch in length, has dark, purplish or bluish-green

Fig. 185.—*Pomphopœa ænea*, Say. After Saunders.

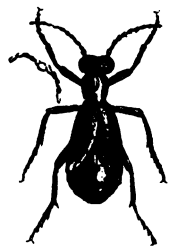


Fig. 186.—*Meloe angusticollis*, Say. After Harris.

Fig. 187.—Head of Snout-beetle; *g. s.*, gular suture.

wing-covers, and a metallic green thorax, head and abdomen. It is sometimes very common in our prairies, where it destroys wild roses and other flowers. It resembles the genuine Spanish fly very closely, and should be gathered and sold to the manufacturing chemists.

The OIL-BEETLES (*Meloe* species), are also included, but they are not numerous enough to cause any damage. Our common species, the *Meloe angusticollis* Say, is shown in Fig. 186.

II. SUB-ORDER RHYNCHOPHORA.

SNOUT-BEETLES; BARK-BEETLES.

This sub-order includes beetles commonly called *Snout-beetles* and *Bark-beetles,* ten families of which are represented in North America. The great peculiarity of these insects is found in the head, which is more or less prolonged into a *beak* or *snout,* sometimes longer than the remainder of the body, but usually

Before beginning to roll up the leaf she gnaws the stem nearly off, so that after the roll is made, and has dried for perhaps a day, it is easily detached by the wind and falls to the ground. When folding the leaf she rolls it up tightly, neatly tucking in the ends until a compact, cylindrical, solid mass of vegetation is formed. Before the leaf is entirely rolled she deposits a single egg, rarely two, in the middle next to the midrib, where it lies loosely in a little cavity. While all this is going on her consort stands near by, and she occasionally runs to him to receive his caresses, then again resumes her work. These rolls sometimes remain on the bushes for several days, but probably drop by

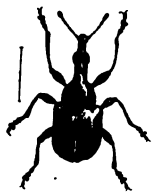


Fig. 188.—*Attelabus analis*, Ill.

Fig. 189.—Thimble-shaped cradles on oak.

the time the larva escapes from the egg, and it seems probable that the grub uses the roll for a shelter until it matures and is ready to enter into its transformations into a beetle." In Minnesota the writer has frequently seen the female at work, but invariably she worked alone, no male being near. In many cases the larva also changes to a pupa inside the cradle, and the latter to a beetle, without entering the ground at all. Evidently love does not always run as smooth here as in the east!

of each projects forward, so that two small and acute teeth seem to project.

We have a number of such small beetles in our state, one of which, of a dark blue-black color, covered with fine and dark hairs, is rather common in various flowers early in the season. Another species, (*Rhynchites bicolor* Fab.), is polished red above, excepting the snout, legs, and under side, which are black, and is sometimes very common and destructive to our roses. It destroys both flower buds and flowers, and deposits eggs into the fruit, in which the young mature. Both wild and cultivated flowers are thus invaded, but especially the former. The beetle measures about one-fourth of an inch in length, not including the long snout which is about as long as the abdomen.

FAMILY ATTELABIDAE.

(*Leaf-rolling Snout-beetles*).

Such beetles have neither an elytral fold nor a labrum; the mandibles are flat, pincer-shaped, and toothed on the inner side. They are mainly interesting from the fact that the females make a compact thimble-shaped roll from leaves, in which a single egg is deposited, and inside of which the larva feeds until full grown, when it leaves and enters the ground for pupation. It is very interesting to see the female at work making such a cradle for its young, and as at least two species are fairly abundant in our state the lover of nature will have but little trouble to observe the whole operation. One species, polished black, with a large dark-red humeral spot, occurs upon our oaks; it is *Attelabus bipustulatus* Fab. The other species, *A. rhois* Boh., occurs upon the hazel and alder; it is brown and densely covered with yellowish-white hairs. The illustration, (Fig. 189), shows a thimble-shaped cradle on oak, and Fig. 188, the adult of *A. analis* Ill.

Prof. Packard describes the operation of making such a cradle as follows: "When about to lay her eggs the female begins to eat a slit near the base of the leaf on each side of the midrib, and at right angles to it, so that the leaf may be folded together.

by jarring the trees, as is done in the case of the plum-curculio described later. The illustration (Fig. 191), shows both shape and size of this beetle and that of the egg and larva.

Mr. Chittenden describes the life-history in one of the admirable bulletins of the Division of Entomology, issued by the Department of Agriculture. He writes that these beetles are sometimes very destructive to strawberry plants, eating the leaves,

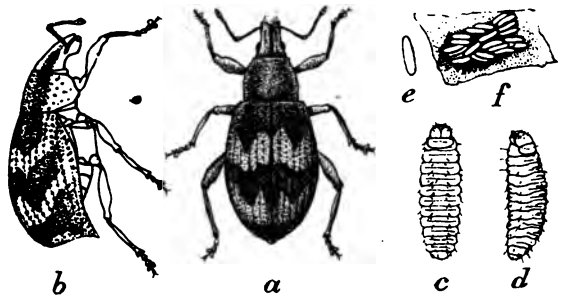


Fig. 191.—*Epicærus imbricatus*, Say.—Division of Entomology, U. S. Department of Agriculture.

and later the entire stem. "The eggs are elongate, more than three times as long as wide, somewhat variable in outline owing to close deposition, sub-cylindrical, sometimes slightly curved on one side, broadly rounded at each end, surface smooth, shining without any apparent sculpture; color light dull yellow." The young larva, when first hatched, is uniform whitish-yellow.

THE GRAY ANAMETIS.

(*Anametis grisea* Horn).

This is another beetle, (Fig. 192, Plate II), last season discovered for the first time in our orchards to be injurious to the apple, in the leaves of which it eats large holes; it likewise eats the tender bark of the same tree. It has the peculiar habit of hiding in the folds of a leaf during the day, on the underside, and is here difficult to detect, as its silvery white color blends well with the white down of the leaves. It is easily beaten into an in-

FAMILY OTIORHYNCHIDAE.

(*Scarred Snout-beetles*).

This family contains a large number of snout-beetles. Their most distinguished characteristic is the presence in the pupal state, and sometimes also in recently matured adults, of an appendage on each mandible, and in the adult state a scar indicates the place from which the appendage has fallen. This scar is on the anterior face of the mandible, and frequently at the tip of a slight process. (Comstock).

Most of our species are more or less ornamented with scales resembling those found upon the wings of butterflies. This is very prominent in tropical species, where such scales are frequently of metallic colors, and are exceedingly beautiful, and on that account are utilized by microscopists for forming baskets filled with flowers of different shapes and colors; such baskets are so minute as to become plainly visible only under a strong lens.

Among the beetles forming this family we possess several species which are more or less injurious to fruit-producing plants.

THE IMBRICATED SNOUT-BEETLE.

(*Epicaerus imbricatus* Say).

This rather omnivorous beetle, gnawing holes in various garden vegetables, is also found on the apple and cherry, injuring them by eating holes in the twigs and fruit. It is by no means common in our state, but destructive in others, hence requires the attention of our fruit-growers. It is a very variable beetle, but usually of a dull silvery-white color, with darker markings; sometimes two light-colored bands extend across the elytra, which are striated with longitudinal rows of deep round pits. This beetle can readily be recognized by the peculiar shape of the posterior end of the elytra, which is very steep, cut off almost squarely, and ends in a sharp and pointed elongation. If it should ever become more numerous than it now is, it can be kept in check

The insect is very convex; the thorax has a projecting angle at each side, and the body is almost egg-shaped.

Judging from the work seen such snout-beetles can become very destructive, and it will be difficult to combat them. Many years ago a snout-beetle infesting the roots of grasses was very numerous in Druid Hill Park, Baltimore, Md., yet its presence was not suspected at all, as no injury to the lawns was noticed, except that the plants seemed to need food, which was provided them in the form of a very bad-smelling manure obtained from cleaning hog-bristles imported from Hungary for the manufacture of brushes, etc. A liberal application of this substance was

Fig. 193.—*Otiorhynchus ovatus*, Linn.

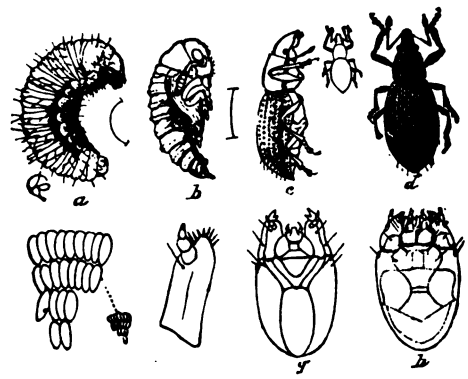


Fig. 194.—*Aramiges Fulleri*, Horn. After Division of Entomology, U. S. Department of Agriculture.

spread over the lawns, and was followed by a heavy rain. Next day immense numbers of beetles (*Sphenophorus parvulus* Gyll.) could be seen upon all the sidewalks and seats on and about the lawn; they were evidently driven out of the ground by this offensive manure. Perhaps this experience might show us a method by which we could combat this and similar insects.

Two other species of the genus *Otiorhynchus* (*O. sulcatus* Fab., and *O. picipes* Fab.), as well as *Thricolepis simulator* Horn, are known to injure the apple elsewhere.

verted umbrella, and if numerous could be captured very readily. It is a robust insect, about the size of the imbricated snout-beetle, of a brownish-gray color. It is not often seen, but by beating apple trees, as suggested above, it will be found to be much more common than was suspected.

Cercopeus chrysorhoeus Say, a similar beetle, is from time to time found on the foliage of the grape, and a number of others occur, but very rarely, upon the flowers and foliage of some of our fruit-producing plants, but none cause any extensive damage.

THE PITCHY-LEGGED OTIORHYNCHUS.

(*Otiorhynchus ovatus* Linn.).

This beetle, a typical one of the family, is getting very numerous, and may, in time, cause injuries to the roots and crowns of straw-berries. It has also been reported as feeding upon the leaves of the apple. Here at the Experiment Station it was not found until four years ago, but now is very abundant, especially very early in spring, just after the snow has disappeared, and again late in autumn. At such times it is found resting on the sides of houses, not far from the ground. In autumn it is ready to enter the ground to hibernate, and in spring it leaves such quarters to enjoy the warmth of the sun. But what attracts such large numbers of beetles to houses is difficult to understand, especially as these buildings are surrounded by well kept lawns. Usually they can be found hibernating among logs and pieces of bark lying upon the ground.

No damages have been observed, but a number of the crowns and roots of strawberries received from other parts of the state tell a sad story, as they were excavated and killed by the larvæ of this beetle. They are much more destructive than the strawberry root-borer, which will be described later.

The beetle, illustrated in Fig. 193, is very dark-brown, almost black; the thorax is very deeply pitted, the pits being sometimes arranged in more or less regular rows; the wing-covers are striated, and at regular intervals in the striæ are deep punctures.

The soft and white larvæ possess no feet, and feed chiefly on fruits, seeds and nuts, but all parts of plants are subject to their attacks.

The female bores a hole with her snout, and deposits an egg in the hole thus formed, pushing the egg to the bottom of it with her beak. For this purpose the snout of a female beetle is very long, sometimes longer than the remainder of the body, as may be seen in the acorn weevil illustrated later.

Although not injurious to fruit-producing plants there are a number of small snout-beetles which are so frequently sent to the entomologist as being injurious to the roots of grasses, that a few words about them may not be out of place. The species of *Sitones,* of which a number occur in our state, are all small, blackish-gray, covered with very minute scales, and in some cases marked with a number of darker spots, interrupted by white, arranged in regular longitudinal rows. Some species are illustrated in Fig. 195.

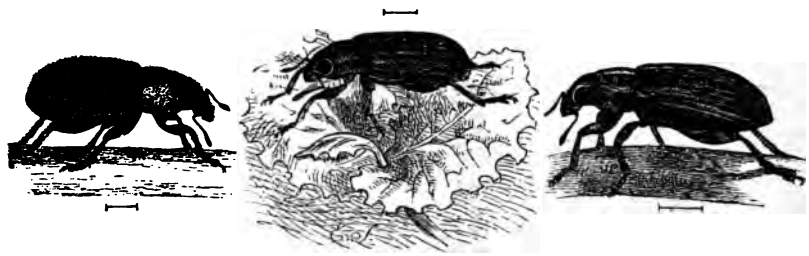


Fig. 195.—*Sitones* species. After Brehm.

THE NEW YORK WEEVIL.

(*Ithycerus noveboracensis* Forster).

This is about the largest snout-beetle we have in our state; it is not only the largest, however, but also sometimes exceedingly destructive, especially so in early spring, when plum trees growing near oak forests are badly injured. In such cases the beetles congregate upon plum and other fruit trees in May or early June, eating the buds and gnawing into the twigs, chiefly at their base,

FULLER'S ROSE-BEETLE.

(*Aramiges Fulleri* Horn).

Some years ago this insect, (Fig. 194), became very injurious in the east in some green-houses devoted to roses. It is an oval, dark, smoky-brown snout-beetle, lightly covered with scales, with a short and obtuse snout; it is about one-fourth of an inch in length. The eggs are laid in masses under any sort of shelter on rose-bushes, and the white and grub-like larvæ hatching from them feed on the tender roots of roses, while the adults destroy leaves, flowers and buds. The attacks of the larvæ weaken the plants, or kill them outright.

Since the long-lived beetles hide during the day on the under-side of the leaves they can be collected and destroyed; the free use of a tobacco extract on the ground will act both as a fertilizer and as a destroyer of the subterranean grubs. The same beetle is sometimes a pest in the orange groves of California, and is replaced by another similar one in those of Florida.

A number of other similar beetles might be mentioned as being sometimes injurious to our fruit-producing plants, but as they are very uncommon in Minnesota, it is not necessary, as all can be destroyed by the remedies already given.

FAMILY CURCULIONIDAE.

(*Genuine Snout-beetles*).

The family *Curculionidae* is the most important of the families of snout-beetles, including more than one-half of all the insects of this character found in the United States, and a large number of them are most destructive insects. In this family there is a strong fold on the lower side of each wing-cover near the outer margin, which limits a deep groove into which the upper edge of the abdomen fits; the mandibles have no scar; the antennæ are usually elbowed, and have a ringed or solid club; the tarsi are usually dilated, with the third segment bi-lobed and spongy beneath; in a few cases the tarsi are narrow, but not spinose beneath. (Comstock).

The soft and white larvæ possess no feet, and feed chiefly on fruits, seeds and nuts, but all parts of plants are subject to their attacks.

The female bores a hole with her snout, and deposits an egg in the hole thus formed, pushing the egg to the bottom of it with her beak. For this purpose the snout of a female beetle is very long, sometimes longer than the remainder of the body, as may be seen in the acorn weevil illustrated later.

Although not injurious to fruit-producing plants there are a number of small snout-beetles which are so frequently sent to the entomologist as being injurious to the roots of grasses, that a few words about them may not be out of place. The species of *Sitones,* of which a number occur in our state, are all small, blackish-gray, covered with very minute scales, and in some cases marked with a number of darker spots, interrupted by white, arranged in regular longitudinal rows. Some species are illustrated in Fig. 195.

Fig. 195.—*Sitones* species. After Brehm.

THE NEW YORK WEEVIL.

(*Ithycerus noveboracensis* Forster).

This is about the largest snout-beetle we have in our state; it is not only the largest, however, but also sometimes exceedingly destructive, especially so in early spring, when plum trees growing near oak forests are badly injured. In such cases the beetles congregate upon plum and other fruit trees in May or early June, eating the buds and gnawing into the twigs, chiefly at their base,

thus causing them to break and fall. The younger bark of twigs is used as food and numerous holes are eaten into it; the tender shoots are entirely devoured, and later they eat the leaves just at their base. The beetle is shown in Fig. 196; it is from four to six-tenths of an inch in length, of an ash-gray color, marked with black; four whitish lines, interrupted by black dots, are on each of its wing-covers, and three smaller ones occur on the thorax. The scutellum, located at the juncture of the elytra with the thorax, is yellowish. Such beetles frequently occur in swarms in nurseries, where they cause serious injury to the apple, plum, cherry, pear, peach and other trees. Fig 196, Plate VI, shows their work.

It is quite abundant in the wooded regions of Minnesota, but is not seen as often as their numbers would warrant, simply because it is a nocturnal insect, hiding in the cracks of bark of oak trees during the day, and in such places it is almost impossible to detect it, as it resembles the bark very closely in color and in markings.

The larva, also shown in the illustration, is found in the twigs and tender branches of the burr-oak, and also in the hickory. According to Saunders, when the female is about to deposit an egg, she makes a longitudinal excavation with her jaws, as shown

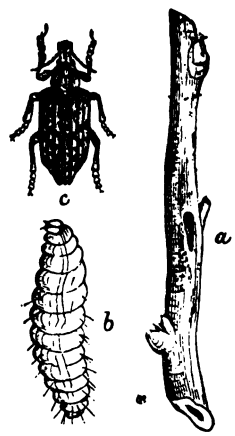


Fig. 196.—*Ithycerus novoboraceusis*, Forst.—After Riley.

Fig. 197.—*Apion* species.—After Brehm.

at *a* in the illustration, eating upwards under the bark; afterwards she turns round and places an egg in the opening. The larva, *b*, is a soft, foot-less grub, of a pale-yellow color, with a tawny head.

There is but one safe way to destroy this beetle; it has to be caught by jarring, the same way as our plum-curculio, since it also has the habit of dropping to the ground when alarmed, as most other snout-beetles do. Paris-green and London-purple, applied in such a way as to make them stick to the tender twigs and branches, will also kill large numbers of this mischief maker.

There is a group of small beetles, (*Apion*), the larvæ of which usually feed in the seeds of plants, as in those of the false indigo, *(Baptisia tinctoria),* the seeds of the locust, and others. To show how these beetles look one has been illustrated, and well shows their peculiar form (Fig. 197). They are equipped with a long and slender projecting beak, have straight feelers, and

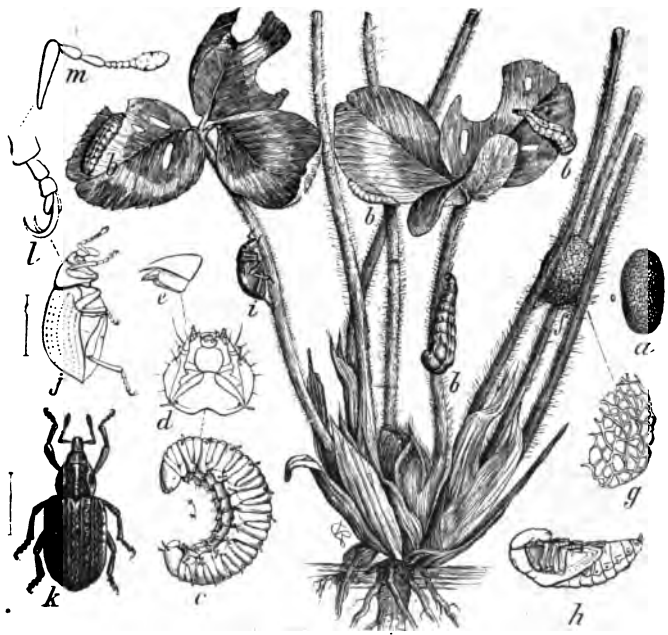


Fig. 198.—*Phytonomus punctatus*, Fab.—After Division of Entomology, U. S. Department of Agriculture.

are very small, the largest not measuring much more than one-tenth of an inch, including the beak. Their colors are black, grayish, dark blue, or even greenish; only a few in the United States are of a brighter color, such as reddish or yellowish.

This is a good place to mention another bad snout-beetle, not yet found in Minnesota, but which is working its way in the direction of our state. It is the *Clover Leaf-beetle* (*Phytonomus punctatus* Fab.). It is a large beetle, dull brown in color, with indefinitely striped elytra, and a short, stout beak. Prof. Smith says about it:

"The larva is green, its form is well shown in the figure, (Fig. 198), and it feeds chiefly at night, eating irregular holes into the leaves. When full-grown it forms a peculiar net-like cocoon, at or a little beneath the surface of the ground, and pupates, becoming adult a few days thereafter. The insects hibernate in the larval stage, and their injury becomes manifest quite early in the season, often threatening entire destruction of the crop when they are full-grown. Fortunately nature has provided a check for this insect in a fungous disease, which in most localities carries off the larvæ annually, just before they mature, leaving only a comparatively small proportion to perpetuate the species. As this disease seems to occur in seasons of all kinds, and irrespective of climatic conditions, it can be easily introduced into any locality in which the insects become destructive. Affected larvæ (Fig. 199), curl themselves round a spear of grass, or on the edge of a leaf, and die, first swelling somewhat and becoming gray in

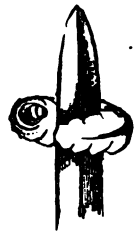


Fig. 199.—*Phytonomus* killed by disease. After Division of Entomology, U. S. Department of Agriculture.

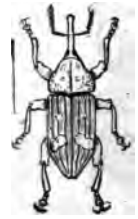


Fig. 200.—*Pissodes strobi*, Peck.—After Division of Entomology, U. S. Department of Agriculture.

color; then they collapse and become black, eventually forming a small, dried, black mass, utterly indistinguishable in character."

We have a number of very noxious snout-beetles which kill our pine trees. Only one will be mentioned and illustrated, (Fig. 200), to show its shape. It is the *White Pine Weevil,* (*Pissodes strobi* Peck). It is one of the most serious enemies to that tree, attacking the leading shoots in young trees, and spoiling their shape entirely. In our extensive pine forests no remedy can even be suggested, but in parks and gardens the small ornamental trees of this kind can be protected to some extent by spraying the

Fig. 201.—European species of Pissodes. After Brehm.

Fig. 202.—*Hylobius confusus*, Kby.—After Brehm.

leading shoots with carbolated soap-wash, to which Paris-green is added at the rate of one pound to one hundred and fifty gallons of water (Smith). Of course the infested shoots should be gathered and burned. Fig. 201 shows a closely related European species.

Equally bad are *Pissodes affinis* Rand., and *Hylobius confusus* Kby. (Fig. 202).

Another group of snout-beetles is composed of very elongate and slender insects, some of which are injurious to garden plants, and on that account one of them is shown in the illustration (Fig. 203). It is the *Rhubarb-beetle,* (*Lixus concavus* Say). This beetle is found early in the season on the leaves and stems of the rhubarb, but is also found on those of wild plants, as on the larger species of *Rumex.* This long, cylindrical beetle, with a thick snout about as long as the head and thorax, is entirely covered with a rusty powder, which rubs off very easily,

and exposes the dark slate-colored body, which is remarkable for its exceedingly firm texture. In fact this insect is so hard that a common insect pin will not perforate it. The beetle bores little holes into the leaf and flower stems of the plant, depositing one egg in each, from which a white, grub-like larva hatches, which devours the plant tissue. The insect is not common in Minnesota. According to Smith, Webster and others, whenever the leaves are regularly cut for the market but little trouble is experienced; old leaves should be removed and destroyed, so that

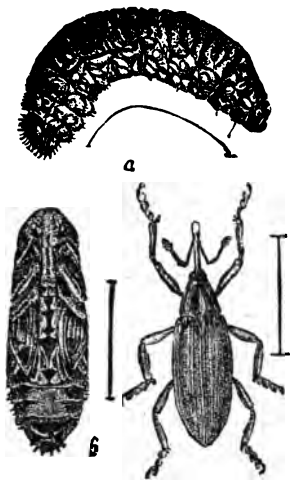


Fig. 203.—*Lixus concavus*, Say. After Webster.

Fig. 204.—*Lixus* from Europe. After Brehm.

none of them remain after midsummer. Several species of *Lixus* occur in our state; a European species found in aquatic plants is shown in Fig. 204.

Among the large number of snout-beetles that follow the above genus in the classification but few are really injurious, although they occur in the flowers of such plants as the strawberries, blackberries, raspberries, and others. Perhaps two species of *Magdalis* are an exception, as the one (*M. aenescens* Lec.) is frequently found upon the apple-tree, and the other (*M. olyra* Hbst.)

has the bad habit of tunneling, in the larval state, into the bark of hickory in every direction, leaving only just enough tissue to prevent the bark from warping away from the tree. Mr. Bowditch states that, "as far as my observations extend, the species appears to prefer small trees, from four to six inches in diameter. If the tree is small and very badly infested it dies very quickly, and shortly after the beetles have escaped, the bark is apt to flake

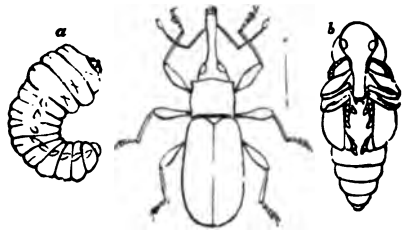


Fig. 205.— *Magdalis olyra*, Herbst. *a*, larva; *b*, pupa. After Packard.

Fig. 206.—*Magdalis armicollis*, Say. After Forbes.

off and curl up in quite large pieces." As a general rule, however, this beetle prefers the red oaks. Fig. 205 shows *M. olyra* Herbst, found abundantly boring under the bark of oak, and Fig. 206 *M. armicollis* Say.

THE PLUM GOUGER.

(*Coccotorus scutellaris* Lec.).

This destructive beetle has been described in the "Second Annual Report of the Entomologist," but to make this report on beetles injurious to fruit-producing plants more complete, it is repeated.

There is no kind of fruit that promises so well in Minnesota as the plum, and wonderful progress has already been made in the past to improve our wild species, and to create, by selection, crosses, or by other means, new and better varieties, and it seems, when we look at the samples of plums shown last year at the different fairs, that before very long fruit superior to all other growing now will be the result of such painstaking work. It seems to the writer that the only true road to success has been chosen, viz.:

to improve the native kinds, which are known to be hardy, and not to attempt to bring to our state others found in countries differing in climate from ours. We have, in improving our native plums, to follow the same steps that were taken in the past in Europe to change their native crab-apples into the beautiful, delicate varieties of apples now grown everywhere. But to grow plum trees and to harvest plums are two quite distinct things. A little observation will almost convince the horticulturist that he is growing the plums not for his own use, but for that of his enemies. He sees that after a plum orchard is once established these have taken possession of the same and seem to consider it their own. There are few plants in Minnesota that have more enemies than the plum-tree: black knot, plum pocket, powdery mildew, brown rot, plum leaf-blight, plum-rust, leaf-spot or gun-shot and others are a few of the more important vegetable foes of this tree, while plant-lice, such as the plum tree aphis, the plum gall-mite, many caterpillars, the plum-gouger, and the plum-curculio, are the more destructive insect enemies.

The plum-gouger, (Fig. 207, Plate V), is the most destructive of the above named insects in Minnesota. It is a reddish-brown snout-beetle, with a peculiar pruinose, almost velvety surface, and is of a very different shape from the better known but less common plum-curculio. In the spring of 1896 the plum trees on and near the Experiment Farm were in full bloom and promised rich returns. But before long one flower after another dropped off, and but comparatively few were left upon the trees, and in some cases none remained. When the cause of this trouble was investigated it was found that this snout-beetle was busily engaged in gouging holes in the flower (see Fig. 207, Plate V), which, in consequence, shrivelled and dropped. A rather suicidal way of doing things, for by acting in this manner the beetles actually destroyed their future food and home! As the fruit grows, the female beetle, in depositing an egg, does not form the crescent-shaped mark of the "Little Turk," but makes for this purpose a small and deep puncture. Prof. Bruner describes the egg-laying habit of the plum-gouger as follows: "The modus

operandi is very simple, and requires but a minute and a half to two minutes for the performance of the entire operation. She first spreads out her legs to their full extent, braces them, and then draws her beak or rostrum to as nearly a perpendicular position as possible, then by gnawing, and with a twisting motion she soon works her snout into the fruit until it is buried a trifle above the bases of the antennæ, the latter being held close against and directed upward along the rostrum upon the head while the hole is being made. She now draws out her beak, and deliberately turns about, and after a few preliminary thrusts of the ovipositor inserts the latter into the hole just made with the beak, and deposits a single egg that is of the diameter of the puncture. The egg is of a dirty whitish, somewhat transparent color, and is plainly visible with an ordinary pocket lens, being uncovered and nearly flush with the surface. It soon becomes covered by a healing of the injured fruit." Each female deposits only one egg in a young plum; if more are found it is the work of different females. The larva that hatches from such an egg is never exposed, hence can not be killed by sprays with arsenical poisons. In entering the fruit a transparent or gummy substance collects over the puncture, as is well shown in the illustration. The larva feeds not only upon the flesh of the plum, but upon the flesh of the kernel inside of the stone. Here it undergoes its transformation from a larva to a pupa and to the adult insect, which later leaves as soon as strong enough to do so, and searches for hibernating quarters in and about the orchard. Many of the plums that contain the worms drop, and should be removed and destroyed, but many others remain on the trees long after the beetles have left, and some of them are even still fit for culinary purposes. There is very little use in spraying. Jarring early in the season, at the time the trees are in full bloom, or even a little sooner, will bring down many of these injurious beetles, and if this is done early in the morning they can be readily gathered and killed. The jarring has to be done in a forcible manner, as the beetles cling very tightly to the tree.

Another species so closely resembling the above species as

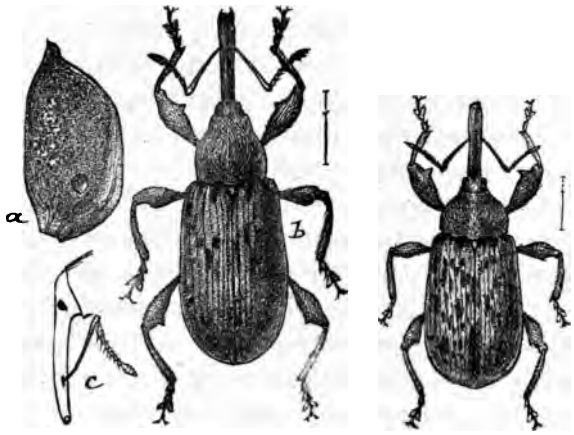


Fig. 208.—*Coccotorus scutellaris*, Lec. and *C. prunicida*, Walsh.—After Division of Entomology, U. S. Department of Agriculture.

to be almost indistinguishable, is found upon the sand-cherry. It has similar life-habits. Both are shown in Fig. 208, and it will be seen that the difference between them is but slight.

In the genus *Anthonomus* we possesss a large number of beetles, all small, with modest colors, but with great power of injury. Only a few of the more important ones will be given.

THE APPLE CURCULIO.

(*Anthonomus quadrigibbus* Say).

This is a common beetle in Minnesota, where it is found breeding almost exclusively in wild crabs and haws, but it is simply a question of time when it will also attack the cultivated apple, which it does in states having older orchards. Prof. Saunders gives the following description of this insect:

"It is a small beetle, a little smaller than a plum-curculio, of a dull brown color, having a long, thin snout, which sticks out more or less horizontally, and can not be folded under the body, as is the case with many species of curculio. This snout in the female is as long as the body; in the male it is about half that length. In addition to the prominent snout, it is furnished with

four conspicuous brownish-red humps towards the hinder part of its body, from which it takes its specific name, *quadriggibus*. Including the snout, its length is a quarter of an inch or more. In the accompanying illustration (Fig. 209), the insect is magnified; *a* represents a back view, *b* a side view; the outline at the left shows its natural size. Its body is dull brown, shaded with rusty red; the thorax and anterior third of the wing-covers are grayish.

"This is a native American insect which formerly bred exclusively in the wild crabs and haws; it is single-brooded, and passes the winter in the beetle state. The beetle appears quite early,

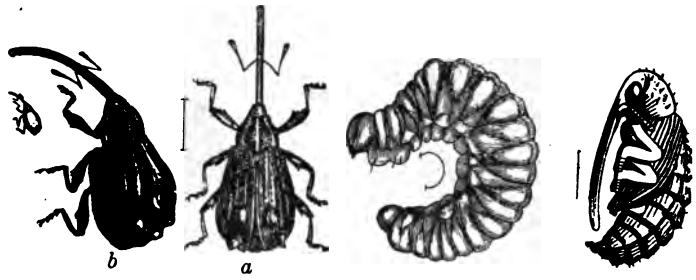


Fig. 209.—*Anthonomus quadrigibbus*, Say. After Riley.

and the larva may often be found hatched before the middle of June, and in various stages of its growth in the fruit during June, July, and August.

"The beetle with its long snout drills holes into the young apples, much like the puncture of a hot needle, the hole being round, and surrounded by a blackish margin. Those which are drilled by the insect when feeding are about one-tenth of an inch deep, and scooped out broadly at the bottom; those which the female makes for her eggs are scooped out still more broadly, and the egg is placed at the bottom. The egg is of a yellowish color, and in shape a long oval, being about one-twenty-fifth of an inch in length and not quite half that in width. As soon as the larva hatches, it burrows to the heart of the fruit, where it feeds around the core, which becomes partly filled with rusty-red excrement.

In about a month it attains its full size, when it presents the appearance shown in Fig 209, which represents the larva and the pupa highly magnified. Fig. 210 shows an infested apple, the egg *c*, and egg-cavity *b*.

"The larva is a soft white grub, nearly half an inch in length, with a yellowish-brown head and jaws. Its body is much wrinkled, the spaces between the folds being of a bluish-black color; there is also a line of a bluish shade down the back. Having no legs, it is incapable of much movement, and remains within the fruit it occupies, changing there to a pupa of a whitish color, and in two or three weeks, when perfected, the beetle cuts a hole through the fruit and escapes.

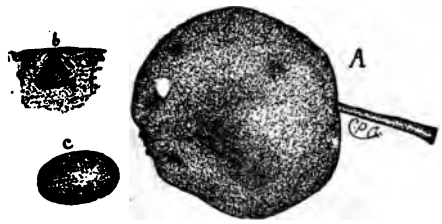


Fig. 210.—Apple containing eggs; *b*, egg-cavity, natural size; *c*, egg, much enlarged. After Gillette.

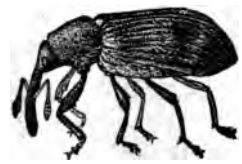


Fig. 211.—*Anthonomus signatus*, Say. After Division of Entomology, U. S. Department of Agriculture.

"When feeding this insect makes a number of holes or punctures, and around these a hard knot or swelling forms, which much disfigures the fruit; pears, as well as apples, are injured in this way. The infested fruits do not usually fall to the ground, as do apples affected by the codling worm, but remain attached to the tree, and the insect, from its habit of living within the fruit through all its stages, is a difficult one to destroy. Picking the affected specimens from the tree, and vigorously jarring the tree during the time when the beetle is about, will bring it to the ground, where it can be destroyed in the same manner as recommended for the plum curculio. Fortunately it is seldom found in such abundance as to do much damage to the fruit-crop. In Southern Illinois, and in some portions of Missouri it has proved

destructive, but in most of the Northern United States, and in Canada, although common on thorn-bushes and crab-apples, it seldom attacks the more valuable fruits to any considerable extent."

THE CRANBERRY CURCULIO.

(*Anthonomus suturalis* Lec.).

About the middle of July we can find numerous beetles of this kind in the blossoms of this plant, but they are also found upon many other kinds. The small beetle is very variable in color, but is usually reddish-brown, with a dark brown head, and a beak about half as long as its body. The pro-thorax is darker than the elytra, and is covered with short, whitish hairs; the elytra are ornamented with rows of indented dots, and are in most cases black along the suture, which color sometimes forms a triangular spot in the middle, of which the whitish scutellum is the center. The beetle measures a little over one-eighth of an inch in length, including the rather long beak. When the female has selected the bud of a blossom she drills, with the snout, a hole through the center, and in this hole she deposits a pale yellow egg. This done, she cuts off the flower stem, which drops to the ground; the egg hatches a dull white grub with a yellow head armed with black jaws with which it devours the inside of a bud, eventually eating its way out, leaving a round hole in the side of the bud, and transforms to a pupa, and soon afterwards to a perfect beetle, which may sometimes be seen feeding upon the berries.

The only remedy in such a case is to flood the cranberry swamp, which will drown the larvæ and pupæ.

THE STRAWBERRY CURCULIO.

(*Anthonomus signatus* Say).

This is one of the most troublesome of the strawberry insects, but as yet is found only in very limited numbers in our state, preferring here to feed in the blossoms of the wild plants. Its history is well known, and the writer had the doubtful pleasure of first observing its actions while assistant of Prof. Riley in Mis-

souri. Prof. Smith writes that it "appears as a small, blackish beetle, with gray pubescence, when the buds are developing, and lays an egg into each, afterwards puncturing the flower-stalk below the bud so as to check further development. The larva feeds upon the pollen in the unopened bud which affords sufficient food till it attains its full growth, changing to a beetle in midsummer. The insect attacks a number of other flowers in the same way, not even confining itself to one natural family, and its injury to strawberries is of a somewhat intermittent character, becoming worse for a number of years, then stopping suddenly for no apparent reason. Only staminate or pollen-bearing varieties are attacked, and the Sharpless is perhaps the most seriously infested. By planting chiefly pistillate varieties the staminate rows may be protected by cheap coverings until the buds are ready to open, and even if only a small crop is obtained on the pollenizers, the main crop will be safe without protection. Insecticides have not proved markedly useful in this case." This species is shown in Figs 211 and 212.

Many other species of the genus *Anthonomus* are found in the flowers of apple, crab, and thorn, and may be more or less injurious; such are *A. profundus* Lec., *A. decipiens* Lec., and *A. crataegi* Walsh, the latter being often very numerous in the flowers of the crab-apples.

Another species of these destructive snout-beetles has of late become very destructive in our cotton growing states, into which it found its way from Mexico. It is *A. grandis,* famous or rather infamous on account of its bad habit of eating into the bolls of cotton, which it destroys.

In Europe many species of this genus attack the flowers of the apple and plum, and are assisted in doing so by other beetles belonging to the genus *Rhynchites* already mentioned. The writer, in watching the English sparrows in the Eastern States, has frequently wondered why these birds should go to the trouble of picking such flowers to pieces, and especially those of the peach. They are so intent upon this work that not infrequently the great majority of the flowers are destroyed, and form a white

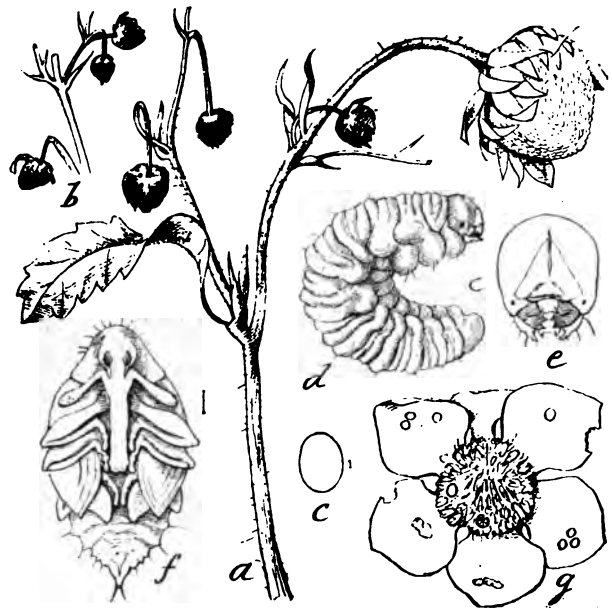


Fig. 212.—*Anthonomus signatus*, Say. Eggs, larva, pupa and injuries. After Division of Entomology, U. S. Department of Agriculture.

sheet beneath the tree. This action of the sparrows can not be done simply out of sheer mischief, but must have another cause. As these birds also pick into similar flowers in Europe to find beetles in them, there can be but little doubt that this habit of investigating flowers is so persistent that even here, after many generations of sparrows have died, their off-spring still possess it, and prompted by it search for insects not found here at all.

The next genus, *Conotrachelus*, also contains numerous destructive members, chief of which is the one described in the "First Annual Report," which is quoted:

THE PLUM CURCULIO.

(*Conotrachelus nenuphar* Hbst.).

We can hardly open an entomological bulletin issued by any of the eastern, central or southern states without finding a description of this insect, and of the remedies that will kill it and

save the fruit. Yet as a very general rule more is claimed for such proposed remedies than is warranted by facts, and many of the measures have not proved very satisfactory. This is especially true of the application of Paris-green and London-purple, which, with the Bordeaux mixture, are nowadays a sort of cure-all. All these substances are of great value, but as far as the "Little Turk" is concerned we have to depend for success very largely upon other methods, which, though requiring much more labor, are also much more certain. Though so well known, it is perhaps best to give an outline of the life-history of this insect, which is illustrated in Fig. 213, Plate III. As the illustration shows, this snout-beetle is less than one-fourth of an inch in length, is of a brown color with four sealingwax-like elevated excrescences on the hard wing-covers. The beetles hibernate among all sorts of rubbish, but prefer accumulated leaves and similar substances. Early in spring, and long before the buds of the plum-trees open, they visit the orchards, and eat the tender parts of the tree, such as green bark and buds; later they eat leaves, flowers and young fruit. Knowing this habit we can kill large numbers of the curculios by spraying the trees before the leaves and flowers appear. This should be done thoroughly, and as the foliage otherwise so very tender as regards arsenical substances is still enclosed, there is no danger of injuring the trees. When the flowers open we should not spray; it is more or less useless, and we run the risk of killing many honey-bees, which are attracted to them, and are very important, as without them but few fruits will set. As soon as the latter have reached the size of a small marble the female curculio commences to deposit her eggs: she makes a crescent-shaped cut and then separates and elevates a small flap into which the egg is inserted. This peculiar crescent-shaped slit has given the insect the name: "Little Turk"; it is made apparently to deaden the flesh of the fruit, or to delay its rapid growth, which otherwise might injure the enclosed delicate egg. This hatches in a few days, and the whitish larva or worm, also shown in the illustration, bores at once into the interior of the fruit until it reaches its stone, which it never enters, however,

as is the case with the plum-gouger, which always does so. The work of the larva is also shown. Though we can not poison the larvæ which are hidden inside the fruit, a second spraying about this time will do some good, as the females continue to deposit their eggs for a long time and require some food. As such spraying will also kill many other injurious insects of the plum-tree, it should not be neglected.

By midsummer the larva has reached its full size, and now leaves to pupate; it does so in the earth beneath the tree, and the pupa soon changes to an adult insect. As soon as able to move the freshly issued beetles search for hibernating quarters, and are not again seen in the orchard until the next spring.

As will be seen from the above account of the habits of this insect, it is not readily combatted by arsenical poisons, though two applications of them will do considerable good. Those who will apply either Paris-green or London-purple for this purpose should recollect that the foliage of the plum is very easily injured by all arsenical poisons, and that it is absolutely necessary to add at least equal parts of quick-lime which will neutralize all soluble arsenic and thus prevent injury.

The old remedy of jarring the trees every day or two over some sheets is after all the most successful one; in doing so during the day, when these beetles are not active, they drop very readily, and can be easily gathered and destroyed. The trees should be jarred, not simply shaken. It seems that by jarring we

Fig. 214.—Machine to catch plum curculios. After Lintner.

imitate the vibrations produced by the hammering of wook-peckers, and the curculios drop to escape them, while shaking simply imitates the motion produced by the wind. There are also a number of patented and unpatented devices to catch these insects by machinery, which jar the tree, collect the beetles, and grind them up. More can not be expected from one machine! A very simple contrivance to collect the beetles is shown in Fig. 214. *All fallen fruit should be picked up* is a rule that should be strictly followed in every orchard. If the owners of trees have no time for this purpose, let them permit turkeys and chicken to do so; even hogs and sheep may be useful.

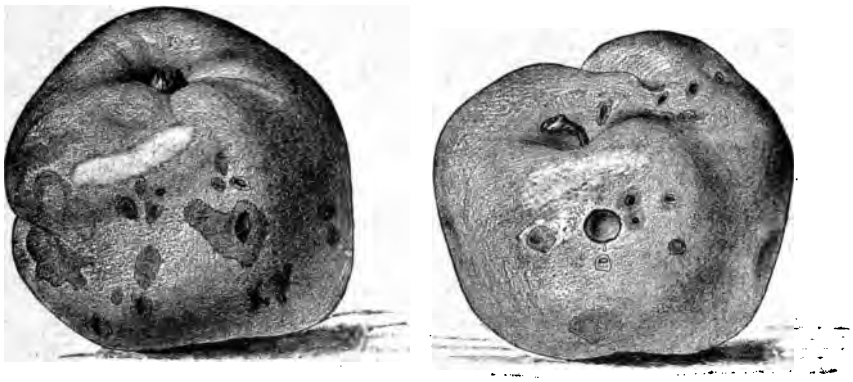


Fig. 215.—*Conotrachelus nenuphar*, Hbst; punctures in apples. After Division of Entomology, U. S. Department of Agriculture.

There are many other methods in vogue, and a few of them are of some use. Shingles laid close to the trunk of a tree, the fruits of which are to be protected, will early in the spring offer a shelter for the beetles that have fed upon the trees during the night, and which, towards morning, leave it—on foot—to hide during the day. By turning over and inspecting these traps one can destroy many beetles.

Although the curculio is well protected as long as still enclosed by the plum, it has nevertheless many enemies, and these destroy large numbers of the full-grown larvæ of the "Little

Turk" when they leave the fruit to enter the ground for pupation. Other insects actually eat into the fruit as it lies upon the ground, to seize the larvæ, drag them out, and eat them. Some of the ground-beetles mentioned before are of great assistance to the fruit-growers, and the *Harpalus pennsylvanicus* De G., illustrated in Fig. 22, is of special importance, as it is very common in our orchards. It's larva is illustrated in Fig. 216, in the act of devouring a curculio larva. Other members of this useful family of insects are also good friends, and should be known as such.

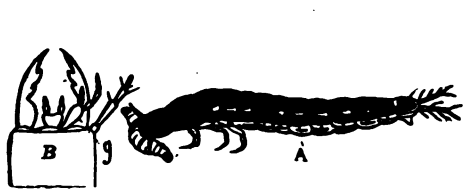


Fig. 216.—***Harpalus pennsylvanicus***, DeG; larva. After Division of Entomology, U. S. Department of Agriculture.

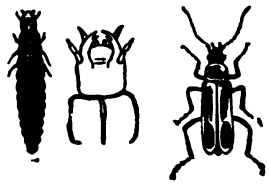


Fig. 217. — ***Chauliognathus americanus***, Forst.; larva and adult. After Riley.

Fig. 217 shows the larva and adult of one of our most common soldier-beetles, *Chauliognathus americanus* Forst. The beetles themselves occur in large numbers on the flowers of the golden-rod; they are yellowish with black markings, as shown in the illustration. Their larvæ frequently work their way into the plum in search of their prey and do this even while the fruit is still on the tree.

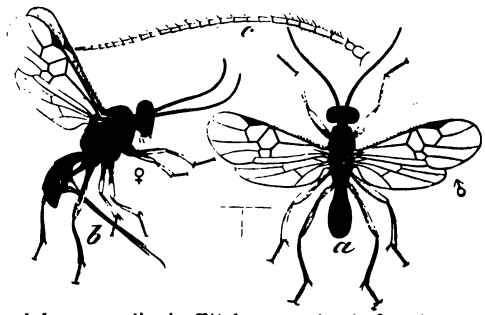


Fig. 218.—***Sigalphus curculionis***, Fitch; *a*, male; *b*, female. After Division of Entomology, U. S. Department of Agriculture.

The larvæ of the "lace-wing flies" are also fond of such fat morsels as the larvæ of the plum curculios, and are not slow to utilize such food whenever they can obtain it.

Ants of many kinds destroy the helpless larvæ as these leave the fruit to enter the ground, and if the latter is kept free of weeds and dusty, many perish before they succeed in entering it. This again shows that clean culture is of benefit in many ways!

It is stated that large numbers of eggs of the curculio are eaten by a minute yellow Thrips, scarcely one-twentieth of an inch long.

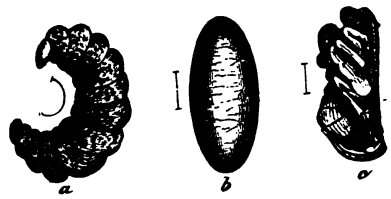


Fig. 219.—*Sigalphus curculionis*, Fitch; *a*, larva; *b*, cocoon; *c*, pupa. After Division of Entomology, U. S. Department of Agriculture.

Besides such cannibal insects we possess other friends, which are true parasites. At least two species are described, both illustrated in Figs. 218, 219, and 220. In some years such parasites are fairly common, and do good work, but as a general rule they do not appear in sufficient numbers to act as an efficient check, and there is but little doubt that if we wish to eat fine plums we will have to work for them, otherwise the curculio will certainly take more than the lion's share.

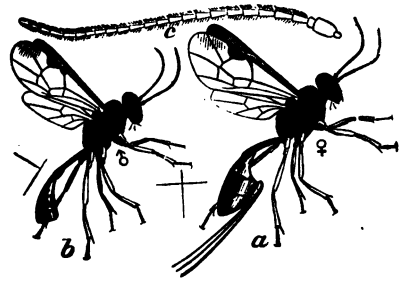


Fig. 220.—*Porizon conotracheli*, Riley; *a*, female; *b*, male. After Division of Entomology, U. S. Department of Agriculture.

THE WALNUT CURCULIO.

(*Conotrachelus juglandis* Lec.).

Looking at the adult of this beetle we are apt to imagine that we have before us simply a very large specimen of the plum-curculio, with the white band across the posterior portion of the wing-covers whiter and more clearly marked. The sealingwax-like projections, which form such a distinctive feature in *nenuphar* are also present, while in all other species of the large genus *Conotrachelus* they are either simply indicated or entirely absent.

The injury caused to our native walnuts and butternuts by these beetles is considerable, as they frequently take more than the lion's share, so that no nuts are left for our use. Infested nuts show the presence of the worm inside by a discolored spot upon the green husk, from which dark-colored masses not infrequently project.

Several other species occur, for instance *C. crataegi* Walsh, in the fruits of hawthorns; *C. elegans* Say, in the partly rolled up leaves of the pig-hickory, which being cut off hang down, wither and turn black; *C. naso* Lec., and *C. posticatus* Say, in the fruit of the haw.

THE QUINCE CURCULIO.

(*Conotrachelus crataegi* Walsh).

As already mentioned this beetle is found in Minnesota, and eats in its larval stage the fruits of the hawthorn; but in the east it has become rather destructive to the quince. As may be seen from the illustration (Fig. 221), it is a broad-shouldered snout-beetle, larger than our enemy, the plum curculio, possessing also a larger snout. It is of an ash-gray color, mottled, in fresh specimens with ochre-yellow or white, with a dusky and almost triangular spot at the base of the pro-thorax; there are seven narrow longitudinal ridges on the elytra, with two narrow rows of rather deep pits between. It is most commonly found during the month of June, when it punctures the young fruit, making a cylindrical hole a little larger than is sufficient to admit the egg;

the hole is a little enlarged at the base. In it the egg hatches into a larva, which does not, however, penetrate to the core, but burrows in the fruit near the surface.

The larva, a little larger than that of the plum curculio, and having a narrow dusky line down the back, matures in about four weeks, when it leaves the quince by a cylindrical opening and drops to the ground. Into this it burrows to a depth of several inches, remaining there until spring, when it transforms to a pupa, and soon afterwards to a beetle. This also feeds upon the quince, sometimes penetrating deeply into it. It also occasionally attacks the pear.

Like the plum-curculio it can be collected in large numbers by jarring; fruit infested, which falls prematurely to the ground, should also be gathered and destroyed.

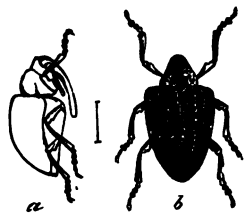


Fig. 221.—*Conotrachelus cratægi*, Walsh. After Riley.

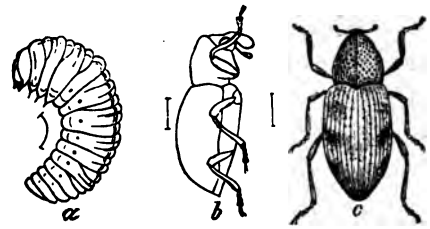


Fig. 222.—*Tyloderma fragariæ*, Ril. After Riley.

It seems that all members of the genus *Conotrachelus* possess similar food habits, and many other plants besides the fruit-producing ones are infested; for instance, the *C. fissunguis* Lec., so frequently found along the shores of tide water swamps in the showy flowers of the *Hibiscus,* feeds as a larva in the bolls of that plant.

There are some species of a closely allied genus, (*Chalcodermus*), which are found as beetles upon the fruit of the dewberry and blackberry, which they destroy. The writer has also seen them in large numbers upon human excrement containing the seeds of these berries.

THE STRAWBERRY CROWN-BORER.

(*Tyloderma fragariae* Ril.).

These beetles are not frequently seen, but the work of their larvæ is apt to become very prominent, as all strawberry plants infested by them are sure to perish. The beetle, shown in Fig. 222, is about one-sixth of an inch long, of a leathery-brown color, with two large black spots on the sides of the elytra, which spots are set off very clearly in fresh specimens, as in such cases they are bordered with heavy white scales, which, however, have almost disappeared in older ones. The prothorax is deeply and uniformly pitted.

Like a number of similar and closely allied beetles, it pretends to be dead when disturbed, and plays possum most perfectly, having the rather short and thick beak completely hidden beneath the head and thorax, and the legs are folded together and bent at the same time so that no one would believe that this object could be a living insect. The beetles appear in June and July, and deposit eggs about the crown of the strawberry plant; when hatched the young larvæ enter the crown, burrow downward, and bore and excavate the substance of the crown until full grown, when they appear as represented at *a* in the illustration. After changing to a pupa the adult beetle appears during the month of August.

Old strawberry plants are more liable to injury than new ones, and the only remedy we possess is to dig up and burn the plants suspected of containing such larvæ as soon as the fruiting season is over.

A number of similar beetles occur in flowers and upon the grape-vine, but as far as known cause no injuries. Both the polished black *T. aereum* Say, and the rougher *T. foveolatum* Say, which is ornamented with white scales arranged in spots, lines, and bands, are common in Minnesota.

The illustration, (Fig. 223, Plate III.), shows a very remarkable snout-beetle (*Tachygonus Lecontei* Gyll.), which feeds on the leaves of oak. It gave the writer a good illustration of the truth of

the old maxim: "there is nothing new under the sun." He found a specimen of this odd-looking being, and wondered why it should possess such long legs, and of such peculiar shape. By spending much time he discovered that the beetle in flying to a young oak tree near by approached the under side of a leaf and threw the legs upwards when they performed the action of an anchor and fastened the insect to the desired spot. When writing down his observations he happened to consult a very old entomological work, and found to his intense surprise—and disgust—that this fact had already been recorded in the year of his birth.

THE GRAPE CURCULIO.

(*Craponius inaequalis* Say).

This almost globular snout-beetle, illustrated in Fig. 224, is by no means common in our state, but has been repeatedly taken from grapes, hence should be mentioned. It is only about one-

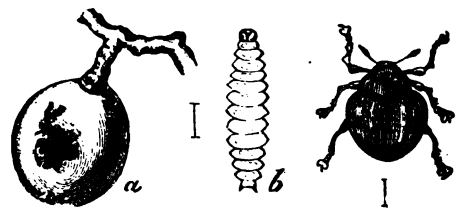


Fig. 224.—*Craponius inæqualis*, Say. After Riley.

tenth of an inch long, black, thickly punctated, and sprinkled with scales forming grayish spots or dots. It seems to pass the winter in the perfect state, laying eggs on the young berries of the grape during June or early in July. The young larva enters the berry and feeds upon it, showing its presence by a discoloration on one side of the same. A dark circular dot can be detected in this discolored spot, which indicates where the larva has entered. Notwithstanding this injury, the affected berry does not decay, but remains sound and hard, although it sometimes drops to the ground before it is fully ripe. The enclosed yellowish-white and translucent larva is an elongated footless grub, with a large, horny,

brownish-yellow head, which reaches its full size late in July or early in August, when it drops to the ground, and entering the same changes to a pupa, and later to a beetle.

Much of the injury caused to the berries of the grape is caused by a small moth, the grape-berry moth, illustrated in the "Fourth Annual Report," and not all the blame should be laid at the door of this beetle, which is seldom numerous enough to cause any serious injury. If this should ever happen it can be gathered by jarring the vine over an inverted umbrella.

Similar in size, shape and general markings are a large number of snout-beetles found in Minnesota. None of them are of much economic importance, with the exception, perhaps, of one species, which forms gall-like swellings on the roots of cabbage. To show their appearance the illustration, (Fig. 225), is reproduced.

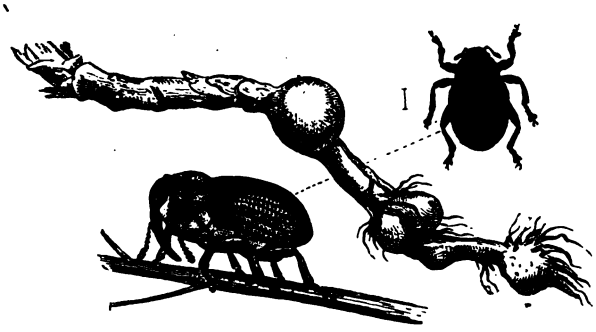


Fig. 225.—Cabbage Curculio. After Brehm.

There is another large group of snout-beetles, some members of which are very numerous in Minnesota, that deserve a passing notice, and the description of a few injurious ones will be given, which, with the illustrations, will give a general idea as to how they appear.

THE POTATO-STALK BORER (*Trichobaris 3-notata* Say) is fairly common. It is a small ash-gray snout-beetle, about one-sixth of an inch in length, with a black snout and three small

black spots at the base of the wing-covers (Fig. 226). The ash-gray color is produced by the numerous scales of that color, which uniformly cover the beetle, and the black spots, sometimes very plainly marked but in other cases entirely absent, seem to be produced by the removal of such scales. Western species are mostly unicolored, eastern possess three larger or smaller spots. This beetle deposits eggs in the stems and larger branches of the potato, Jimpson weed, and perhaps other *Solanaceae;* the resulting white larvæ feed there until midsummer, when, at the time the

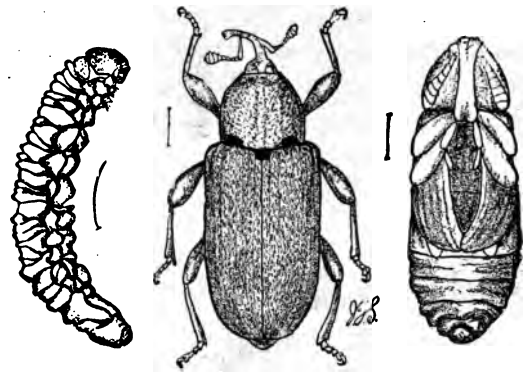


Fig. 226.—*Trichobaris 3. notata*, Say. After Smith.

plant matures, they change to pupæ and beetles, the latter remaining in the burrows until spring. Knowing their life-history it is of course very simple to suggest the proper remedy, i. e., to burn the dead potato-vines as soon as the crop is harvested.

Many other and similar snout-beetles are found, which, as a rather general rule, are polished black, with numerous fine striæ upon their wing-covers.

THE GRAPE-VINE GALL-BEETLE.

(*Ampeloglypter Sesostris* Lec.).

This, as well as *A. ater,* produces curious gall-like swellings on the stems of the grape-vine, which have received the name *Vitis vulnus* Ril. Such galls are not uncommon on the wild and

cultivated grape vines, being elongated knots or swellings, usually situated immediately above or below a joint, as shown in Fig. 227. Frequently the gall shows a longitudinal depression on one side, dividing it into two prominences, usually distinguished by a rosy tint. The architect of such a gall is a small beetle about one-eighth of an inch long, of a reddish-brown to black color, with a rather stout beak, half as long as its body. The entire beetle is highly polished; the thorax is punctated, and the wing-covers are without any markings, but have a sort of wavy surface, in certain lights producing the effect of being marked as shown in the illustration. The adult insect is found early in July; the female at this time punctures the stem of the vine, and deposits an egg which

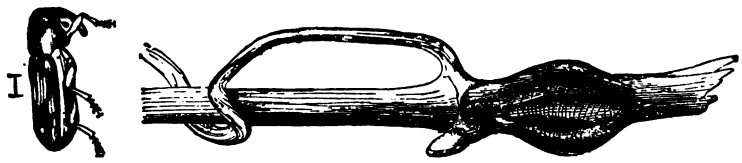


Fig. 227.—*Ampeloglypter Sesostris*, Lec. After Riley.

soon hatches into a whitish grub that feeds within the swollen part of the vine. It remains inside the gall until June of the following year. A full grown larva is about a quarter of an inch long, white, cylindrical, footless, with a large yellowish head. During June it changes to a pupa, and soon afterwards to a perfect beetle.

These beetles are not numerous enough to cause any extensive damage, and as the galls can readily be seen, they can be cut off and burned. Since we trim our vines in the autumn, before burying them in the ground to prevent freezing, there is no danger that this snout-beetle should ever become injurious, and especially if we gather the cut off vines and burn them. Our numerous wild grapes, however, will always produce a crop of such beetles.

A related species, the *A. ater* Lec., which is very similar to the *Sesostris*, forms gall-like swellings on the leaf-stalks of the

Virginia creeper, and in this case at least the beetles mature inside them before the summer is past, indicating, perhaps, that it is double-brooded.

Still another similar but larger beetle is frequently found upon the grape vines and other plants; it is *Madarus undulatus* Boh., and is a very singular looking insect, very highly polished, entirely black, and with a bright reddish pro-thorax. The surface of the wing-covers are undulating, hence the specific name.

The genus *Balaninus* contains a number of very peculiar beetles, frequently called "Nut-weevils" (Fig. 228). All of them

Fig. 228.—Nut-weevil. After Brehm.

confine their attention to the different kinds of hazelnuts, chestnuts, acorns, and hickory nuts; hence are injurious where nuts as chestnuts and pecans are grown for the market.

In Minnesota we have a large number of such beetles, and the lover of freshly-picked hazel nuts is frequently greatly disappointed in finding a fat worm instead of a sweet kernel. People buying chestnuts are equally disgusted with their bargains and for the same reason. The great majority of acorns are equally infested. All our species of *Bolaninus* are large beetles.

THE CHESTNUT WEEVIL.

(*Balaninus caryatrypes* Boh.).

As this species shows the forms of all members of this genus it is described and illustrated in Fig. 229. It is the largest, and like the others, of a clay-yellow color, marked with brown spots arranged in wavy lines. It has an exceedingly long and slender black beak, which in the female is longer than the entire insect, and is gracefully curved; in the male the rostrum is not much longer than the wing-covers. Dr. Le Conte, in his work on "The Rhynchophora of America," remarks that the beak of these beetles attains in length and attenuation the greatest development;

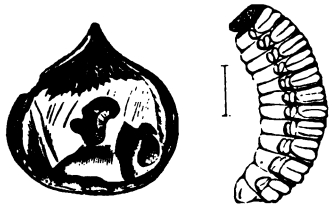


Fig. 229.—*Balaninus caryatrypes*, Boh. After Division of Entomology, U. S. Department of Agriculture.

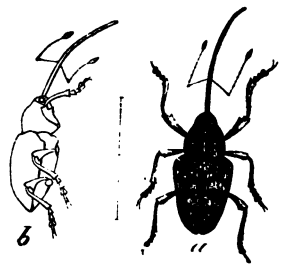


Fig. 230.—*Balaninus rectus*, Say. After Division of Entomology, U. S. Department of Agriculture.

in the male it is rarely shorter than the body, in the female it is frequently twice the length, and is used to make the perforation into which the egg is subsequently introduced. The great thickness of the husks of the fruit, (chestnuts, walnuts, hickory nuts, etc.) attacked by these insects necessitates a very long perforating instrument to reach the kernel upon which the larva feeds. The chestnut is often badly infested by this large white maggot with a yellowish head, which attains its full size at the time the nuts drop. It is found in nuts sent to the market, and it is probable that while some of the maggots gnaw their way out, and enter the ground in the autumn to transform, others delay until the spring, and this is but natural, as the adults are found almost throughout the warmer portions of the year, depositing eggs dur-

ing the greater part of this period. The worms devour nearly one-third or one-half of the interior of the nut, part of the cavity being filled with the castings of the worm. As the grub is white it is liable to be overlooked and eaten with the chestnut; when mature it leaves through a round hole and drops to the ground, into which it enters to some depth, and here it hibernates, changing to a beetle in the spring.

People in more southern regions, who raise chestnuts for the market, lose considerably by the attacks of this grub. The only remedy against the beetle consists in gathering the nuts as soon as they fall, and either shipping them at once, or else storing them in tight boxes and barrels, from which the larvæ can not escape. Here they gather in large numbers at the bottom, and can easily be killed with boiling water.

We have a number of species, which are found in acorns. *B. rectus* Say, one of them, is illustrated in Fig. 230.

FAMILY BRENTHIDAE.

(*Brethids*).

Only a single species is found in our state, the family being confined to tropical regions, where a large number of very peculiar forms exist. Our species, the *Eupsalis minuta,* Drury, although

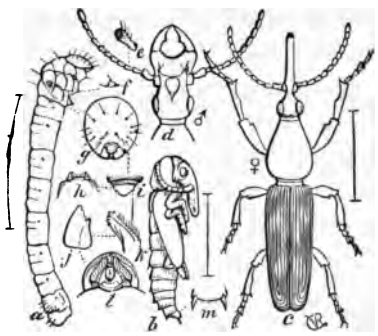


Fig. 231.—*Eupsalis minuta*, Drury. After Riley.

Fig. 232.—*Brenthus anchorago* Linn ; male and female. After Brehm.

THE WALNUT CURCULIO.

(*Conotrachelus juglandis* Lec.).

Looking at the adult of this beetle we are apt to imagine that we have before us simply a very large specimen of the plum-curculio, with the white band across the posterior portion of the wing-covers whiter and more clearly marked. The sealingwax-like projections, which form such a distinctive feature in *nenuphar* are also present, while in all other species of the large genus *Conotrachelus* they are either simply indicated or entirely absent.

The injury caused to our native walnuts and butternuts by these beetles is considerable, as they frequently take more than the lion's share, so that no nuts are left for our use. Infested nuts show the presence of the worm inside by a discolored spot upon the green husk, from which dark-colored masses not infrequently project.

Several other species occur, for instance *C. crataegi* Walsh, in the fruits of hawthorns; *C. elegans* Say, in the partly rolled up leaves of the pig-hickory, which being cut off hang down, wither and turn black; *C. naso* Lec., and *C. posticatus* Say, in the fruit of the haw.

THE QUINCE CURCULIO.

(*Conotrachelus crataegi* Walsh).

As already mentioned this beetle is found in Minnesota, and eats in its larval stage the fruits of the hawthorn: but in the east it has become rather destructive to the quince. As may be seen from the illustration (Fig. 221), it is a broad-shouldered snout-beetle, larger than our enemy, the plum curculio, possessing also a larger snout. It is of an ash-gray color, mottled, in fresh specimens with ochre-yellow or white, with a dusky and almost triangular spot at the base of the pro-thorax; there are seven narrow longitudinal ridges on the elytra, with two narrow rows of rather deep pits between. It is most commonly found during the month of June, when it punctures the young fruit, making a cylindrical hole a little larger than is sufficient to admit the egg;

Prof. Smith writes as follows about such beetles: "In many localities corn is attacked soon after it shows above ground by insects known as 'Corn Bill-bugs.' (In eastern Maryland and Virginia they call corn injured by such beetles 'Frenchy,' in the same way in which they call the Thrasher, a singing bird inferior in song to the Mocking-bird, the 'French Mocking-bird'). These belong to the genus *Sphenophorus*, and are blackish or brown, rarely gray in color, varying from one-fourth to one-half an inch in length, with very thick and hard wing-covers, which

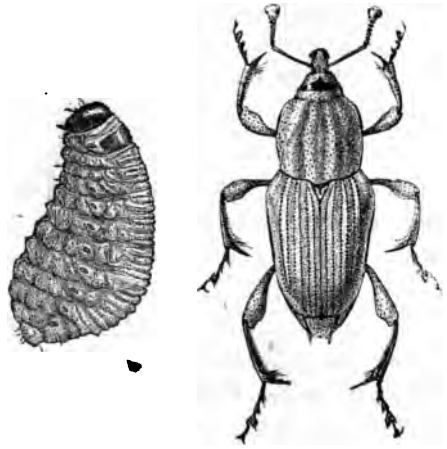


Fig. 238.—*Sphenophorus ochreus*, Lec.; larva and adult. After Division of Entomology, U. S. Department of Agriculture.

are ridged and punctured, as is also the thorax. They hide in the soil at the base of the corn-plants during the day, and kill them by boring little round holes in the stem. They are most frequently after timothy, especially on old sod; or when corn follows sedges or bulb-rooted grasses. It is in such places that the larvæ live naturally, pupating in fall or early spring, and the beetles, finding that their natural food is gone on spring plowed land, attack the corn, which replaces it, and is nearly enough like it to be to their taste. The period of injury is usually short, and if replanting is delayed a little, the new shoots escape attack. Fall-plowing old timothy-sod or sedge-land is always indicated, and

will generally serve to reduce if it does not entirely prevent injury."

Some other closely related beetles are only too well known. They are the grain and rice-weevils, belonging to the genus *Calandra*. These insects, similar in shape to those just mentioned but hardly exceeding one-eighth of an inch in length, infest stored grain of all kinds and have become almost cosmopolitans, being brought to nearly all parts of the globe by commerce. They are black or brownish-red, sometimes marked with lighter-colored

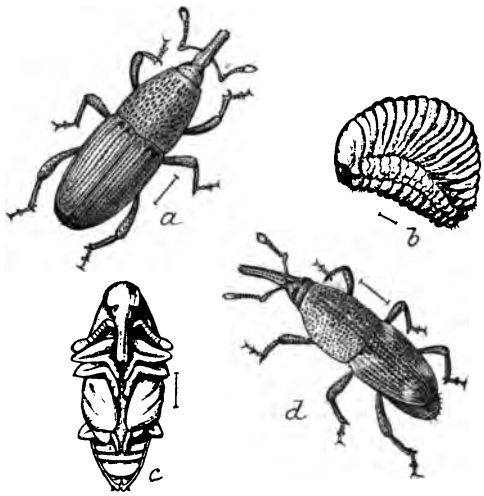


Fig. 234.—*Calandra granaria*, Linn.; *a*, beetle; *b*, larva; *c*, pupa; *d*, *C. oryza*, Linn.—All enlarged. After Division of Entomology, U. S. Department of Agriculture.

spots as indicated in the illustration (Fig. 234*d*). Wherever grain of all kinds, or rice, is stored for any length of time, these insects are sure to be attracted, and are as certainly apt to multiply very rapidly, so that before long the grain-bins are overrun by myriads of them. In some mills, breweries and similar places they are so numerous that they become a very great pest, and it is difficult to get rid of them in such places. The only prevention is cleanliness and the rapid removal of stored grain. They prefer dark places, therefore a flood of sunlight will prevent their rapid increase. After removal of the grain all cracks should be

made tight, so as to do away with hiding places. In bins that can be made fairly tight, these insects can easily be controlled by the use of bisulphide of carbon. This is poured on the grain, covering it afterwards with canvas or any other similar material to prevent the too rapid escape of the fumes, which, being heavier than air, gradually permeate the entire mass, killing everything in it without causing any injury to the seeds themselves. It is best to do this work after working hours, at all events away from any fire, as the fumes of this chemical are inflammable, and may otherwise kill the insects in a most unexpected, though very effective way.

Numerous other and similar insects are often found under the bark of trees, especially that of the pine. All such beetles are very similar in shape, most are highly polished, others are roughly punctured and gray.

FAMILY SCOLYTIDAE.

(Bark-beetles, Engraver-beetles).

"Engraver-beetles" are so named because they make burrows of more or less regularity between the bark and the sap-wood, as may be seen in the illustration, (Fig. 235), which illustrates the work of the Hickory-bark Borer, (*Scolytus 4-spinosus* Say). Some of these beetles are also called "shot-hole borers," from the little round holes with blackened edges which they make in wood and bark; and still others are called "Ambrosia Beetles," because the insects actually plant the spores of a fungus in the burrows made in solid wood upon which they and their larvæ live. Most of the members of this large family attack forest trees, and those interested in them should read the excellent work of Dr. Packard, already referred to.

Bark-beetles are mostly small, some almost microscopic, the larger ones rarely exceeding a quarter of an inch in length. Their form is cylindrical, the hind end of the body is frequently very blunt, or even cut off squarely; the feelers are short; elbowed or bent in the middle, ending in knobs at the tip; the tibiæ are usu-

Fig. 235.—*a*, work of *Bostrichus; b*, that of *Eccoptogaster*. After Brehm.

ally serrate, and the pygidium is surrounded at the edge by the wing-covers, which have the fold on the inner side well developed. In many cases the edges of the declivity of the wing-covers are toothed or serrated in various ways, though in others they are normal. They also differ from the other snout-beetles in possessing a very short snout, which is scarcely more than a slight prolongation of the head.

The larvæ are similar to those of the genuine *Curculionidae*, but have stronger jaws to adapt them for boring into hard wood. Their method of doing so is very peculiar, and differs in the different genera composing this family. Some bore between the bark and solid wood, several working from a common center; the burrows, which gradually widen to the place of exit, radiate

in all directions, making fanciful carvings and engravings on the inner side of the bark and the surface of the wood, hence the name "engravers."

Many species have a habit similar to the one quoted by Prof. Comstock from Dr. Lindemann, who writes: "that in the case of *Tomicus typographus* the original tunnel is begun by the male, who makes a little chamber in the bark; afterwards the female comes to him in this chamber, and later she continues the mine begun by her mate, making the long central tunnel from which the tunnels of her off-spring extend. Thus we see that all the members of a single family have a share in making one of these engravings."

Whenever a tree has been invaded by a number of such insects the trees are killed, and in other cases the timber is greatly injured by the burrows in the solid wood. It seems as if these beetles preferred sick or dying trees, in which case they act simply as scavengers, removing the dead material to make room for new growth. Beside forest trees, fruit-trees are also attacked by some members of this large family, and in some very few cases even the roots of the clover suffer.

Those interested in such beetles should not fail to read the important work of Dr. A. S. Packard, published by the U. S. Department of Agriculture, entitled: "Insects Injurious to Forest and Shade Trees," or the most interesting paper on "Ambrosia Beetles" by H. G. Hubbard in a recent bulletin (No. 7) of the Division of Entomology, Washington, D. C., and the valuable bulletin (No. 56) of the West Virginia Experiment Station by A. D. Hopkins.

THE APPLE BARK-BEETLE.

(*Monarthrum mali* Fitch).

In the genus *Monarthrum* the sexes are alike, and the males assist the females in forming new colonies. Mr. Hubbard writes: "The young are raised in separate pits or cradles, which they never leave until they reach the adult stage. The galleries, con-

structed by the female beetles, extend rather deeply into the wood, with their branches mostly in a horizontal plane (Fig. 236).

"The mother beetle deposits her eggs singly in circular pits which she excavates in the gallery in two opposite series, parallel with the grain of the wood. The eggs are loosely packed in the pits with chips and material taken from the fungus bed, which she has previously prepared in the vicinity, and on which the ambrosia has begun to grow.

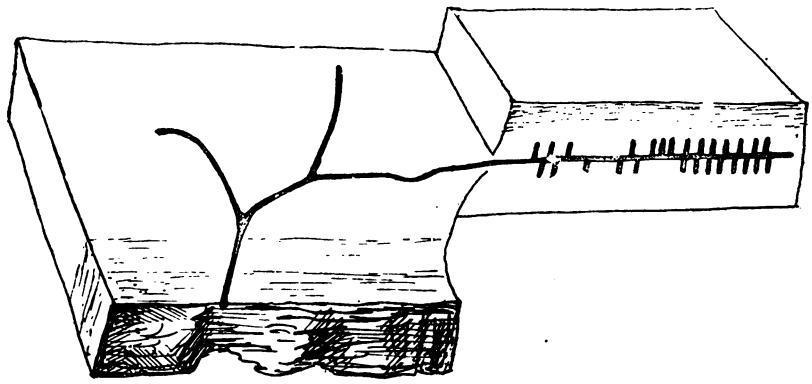


Fig. 236.—Burrows of *Monarthrum mali*, Fitch. After Division of Entomology, U. S. Department of Agriculture.

"The young larvæ, as soon as they hatch, eat the fungus from the chips, and eject the refuse from their cradles. At first they lie curled up in the pit made by the mother, but as they grow larger they deepen their cradles with their own jaws, until, at full growth they slightly exceed the length of the larva when fully extended. The larvæ swallow the wood which they excavate, but do not digest it. It passes through the intestines unchanged in cellular texture, but cemented into pellets by the excrement, and is stained a yellowish color. The pellets of excrement are not allowed to accumulate in their cradles, but are frequently ejected by them, and are removed and cast out of the mouth of the boring by the mother beetle. A portion of the excrement is evidently utilized to form the fungus garden bed. The

mother beetle is constantly in attendance upon her young during the period of their development, and guards them with jealous care.

"The mouth of each cradle is closed with a plug of the food fungus, and as fast as this is consumed it is renewed with fresh material. The larvæ from time to time perforate this plug and clean out their cells, pushing out the pellets of excrement through the opening. This debris is promptly removed by the mother, and the opening again sealed by ambrosia. The young transform to perfect beetles before leaving their cradles and emerging into the galleries.

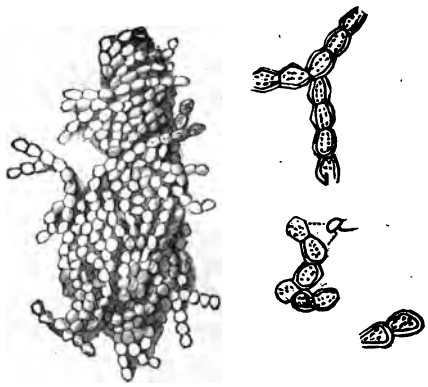


Fig. 237.—Ambrosia of *Corthylus punctatissimus*, Zimm.; *a*, detached bumb-bell shaped pairs of cells, greatly enlarged. After Division of Entomology, U. S. Department of Agriculture.

"The Ambrosia of *Monarthrum* (Fig. 237), is moniliform, and resembles a mass of pearly beads. In its incipient stages a formative stem is seen which has short joints that become globular conidia and break apart. Short chains of cells, sometimes showing branches, may often be separated from the mass. The base of the fungus mass is stained with a tinge of green, but the stain in the wood is almost black.*

"Two species, *M. fasciatum* Say, (Fig. 238), and *M. mali* Fitch (Fig. 239), are confined to the Atlantic forests, and range in latitude from Lake Superior to Florida. They have identical

*By mistake the ambrosia of another closely related beetle has been illustrated.

habits, and feed upon the same fungus. They are commonly associated in the same tree-trunk, and not seldom occupy galleries having a common entrance hole. Both species are known to attack wine casks, but they probably breed only in dying trees."

The trees attacked include oak, hickory, beech, maple, aspen, apple and orange, and the list might be extended to include other hardwood timber.

According to Fitch the insects sometimes attack young and thrifty trees, which, when badly affected, are apt to suddenly wither soon after putting forth their leaves, as if scorched by fire; the bark becomes loosened from the wood, and soon afterwards these small beetles appear crawling through minute perforations, like large pin-holes, in the bark.

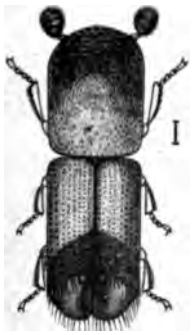


Fig. 238.—*Monarthrum fasciatum*, Say. After Division of Entomology, U. S. Department of Agriculture.

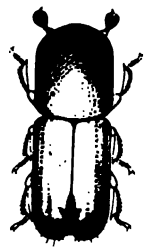


Fig. 239.—*Monarthrum mali*, Fitch. After Division of Entomology, U. S. Department of Agriculture.

From the above description by Mr. Hubbard it is seen that such beetles are genuine gardeners, since they do not consume wood but minute and juicy fungi propagated on the walls of their galleries. All the growing parts of the fungus are extremely succulent and tender, but remain in that condition only when continually cropped; if allowed to go to seed it is no longer useful as food. Mr. Hubbard also states that when their galleries are disturbed and opened to day-light, the adult beetles generally fall to eating their ambrosia as rapidly as possible. Like other social

insects they show their concern at the threatened loss of their most precious possession by trying to save it, just as bees, when alarmed, fill themselves with honey.

As far as remedies are concerned, it is evident that any method by which the entrances of their galleries in the bark can be closed, will effectually put an end to the progress of their colonies, and perhaps the best means to do so is by coating the trunks with dendrolene or "raupenleim." Valuable fruit-trees, which have suffered from fire or frost, can not be protected in this manner, as the buds, which must be allowed to grow on the trunks, would be injured or destroyed. In such cases it is best to plug the holes with a piece of wire, which is inserted as far as it will go and then cut off.

THE PEAR-BLIGHT BEETLE.

(*Xyleborus pyri* Peck).

During the heat of midsummer the twigs of the pear-tree sometimes become suddenly blighted, the leaves and fruit wither, and a discoloration of the bark takes place, followed by the speedy death of the affected part. This trouble is not caused by the well known fire-blight, which is a disease and is of a totally different character, and is entirely independent of any insect. The injuries

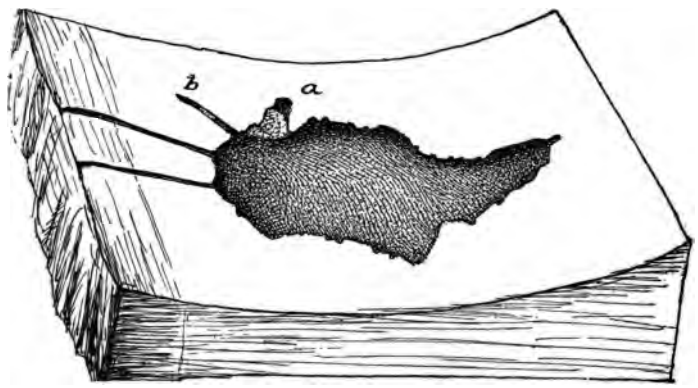


Fig. 240.—Gallery of *Xyleborus xylographus*, Say; in hickory; *a*, *b*, death, chambers. After Division of Entomology, U. S. Department of Agriculture.

are not confined wholly to the pear, but the same insect occurs also on the apple, the plum, and the apricot.

According to Hubbard the members of this genus of beetles also exist upon ambrosia, which is grown by the females for the purpose of feeding the young, as has already been described.

Each species of beetle grows its own kind of ambrosia, and the galleries made are of a different character, as may be seen in the case of *X. xylographus* Say, illustrated in Fig. 240, where the young are assembled in a large brood chamber, constructed at the end of a gallery which penetrates deeply into the heart of the tree, or remains in the sap-wood, according to the amount of moisture in the trunk. The chamber is somewhat leaf-shaped, and stands vertically on edge, parallel with the grains of the wood.

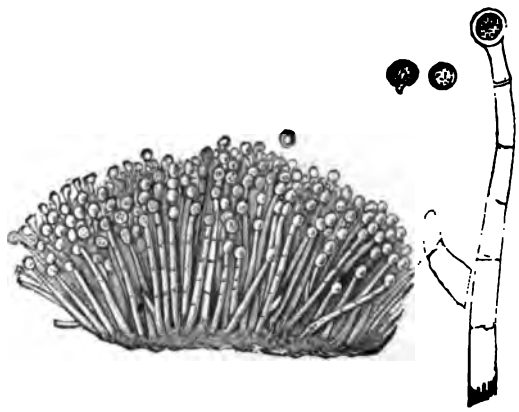


Fig. 241.—Ambrosia of *Xyleborus xylographus*, Say. After Division of Entomology, U. S. Department of Agriculture.

The space between the walls is not much greater than the thickness of the bodies of the adult beetles. The larvæ of all ages are able to cling to the vertical walls, and to progress over them by an adaptation of the end of the body, which aids them in advancing. The entire surface of the walls in the brood chamber is plastered over with ambrosia fungus, a representation of which is given in Fig. 241. It consists of short, erect stems, terminating

in spherical conidia. The freshly grown fungus is colorless as crystal, but it is usually more or less stained with greenish-yellow, and sometimes looks like a coating of sublimed sulphur. The brood chamber is at times packed with eggs, larvæ, pupæ and adults, in all stages of maturity. The larvæ aid in extending the brood chamber. They swallow the wood which they remove with their jaws, and in passing through their bodies it becomes stained a mustard-yellow color. Great quantities of this excrement are ejected from the openings of the colony, but a portion is retained and plastered on the walls, where it serves as a bed upon which a new crop of the fungus springs up. In populous colonies it is not unusual to find the remains of individuals who have died packed away in a deep recess of the brood chamber, carefully enclosed

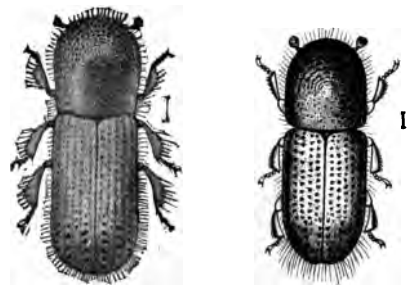


Fig. 242.—*Xyleborus xylographus*, Say; female and male. After Division of Entomology, U. S. Department of Agriculture.

with a wall of chips. At *a* in Fig. 240 such a catacomb is shown, which was found to contain the mutilated bodies of a dozen or more larvæ and immature imagos, together with the fragments of a predatory beetle, *Colidium lineola* Say. This tomb bears testimony to a sanguinary conflict in which victory crowned the efforts of the ambrosia beetles. The bodies of the slain, both friend and foe, have been consigned to the same sepulchre. In the same figure, at *b*, a short branch of the gallery is shown containing the lifeless body of the mother of the colony, who appears to have constructed her own tomb, and to have crawled into it as she neared her end. The mouth of this tomb has also been sealed

up by the survivors. Both male and female of *Xyleborus xylographus* Say are shown in Fig. 242.

A number of very minute beetles, belonging to the genera *Hypothenemus*, and *Pityophthorus*, mine under the bark of the apple, walnut, hickory, chestnut, and others. None are very destructive, however, as they are usually found in dead or dying twigs, and none of them have such interesting habits as the ambrosia-beetles, since their food consists of wood and not of fungus grown by the mothers.

THE FRUIT BARK-BEETLE.

(*Scolytus rugulosus* Ratz.).

This beetle, not yet found in Minnesota, but uncomfortably near it, needs a description, so that fruit-growers may recognize this pest in time to combat it successfully. Prof. Smith gives a full account of it in his text-book already mentioned, which is here quoted:

"*Scolytus rugulosus*, the 'fruit-bark beetle,' is, perhaps, the best known, and certainly the most important economically, attacking deciduous forest trees of almost all kinds. The black parent beetles appear in early spring, and bore little round holes through the bark to the sap-wood. They then make a central burrow, on each side of which little notches are made to receive the soft white eggs. The larvæ hatch very soon, and at once begin to make little burrows of their own, diverging as they move from the parent channel, and gradually enlarging them as they increase in size. When full grown they form a slightly enlarged chamber, in which they pupate, and when they transform to little beetles make their way out through little round holes in the bark. The whole period of development does not exceed a month, and there may be several broods during the summer from the same tree, the numerous galleries eventually girdling and killing it.

"These insects rarely attack sound and healthy trees, and this is a peculiarity of bark-beetles in general, though there are many exceptions. But just as soon as a tree becomes a little weakened

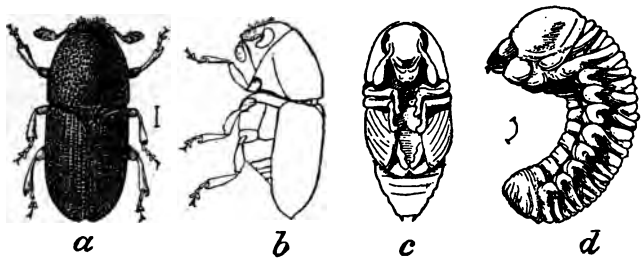


Fig. 243.—*Scolytus rugulosus*, Ratz.; *a*, adult; *b*, same in profile; *c*, pupa; *d*, larva. After Division of Entomology, U. S. Department of Agriculture.

through injury or from starvation, these little creatures attack it, and then its doom is sealed, unless vigorous measures are taken at once. Peach trees are especially susceptible to injury, and the gummy oozing from the little holes seems to weaken them so rapidly that they succumb in a short time.

"It is good practice to keep orchard trees in the best possible health and vigor at all times to enable them to resist naturally

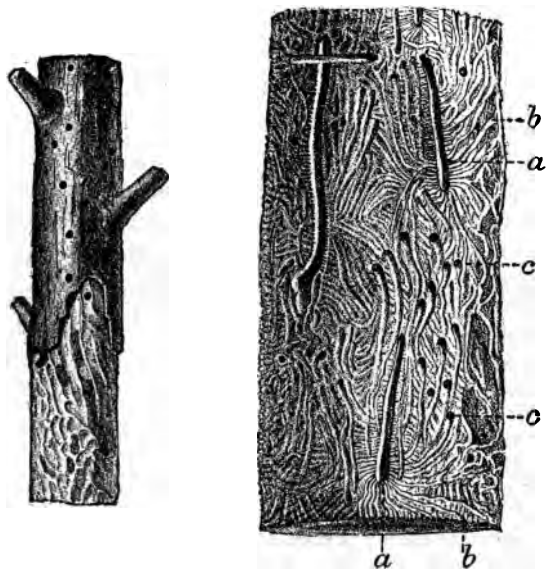


Fig. 244.—Work of *Scolytus rugulosus* in twig of apple; and to the right, galleries under bark; *a*, *a*, main galleries; *b*, *b*, larval galleries; *c*, *c*, pupal cells. After Division of Entomology, U. S. Department of Agriculture.

the attacks of these insects, but if one does become seriously infested it should be at once cut out and burned. It is certain to die in a short time, and it is a constant menace to surrounding trees from the abundance of specimens which will be produced, ready to attack others at the least sign of weakness. Where a slight infestation is noticed on a tolerably healthy tree, it should be closely examined to ascertain the original source of weakness, and when this is removed the tree should be stimulated by means of appropriate fertilizers, and the trunk kept covered by white-wash to which Paris-green has been added. Strong whale-oil soap-suds will answer the same purpose, and a little crude carbolic acid will add to its effectiveness. In all cases the application should be thorough, and should be kept intact until the tree has fully recovered and is able to take care of itself. The beetle is shown in Fig. 243, and its burrows in Fig. 244."

The same line of treatment is adapted to other bark-beetles, varied according to the differences in life-history.

THE HICKORY-BARK BEETLE.

(*Scolytus 4-spinosus* Say).

This beetle confines its work to all kinds of hickory, in which it makes long and slender tracks under the bark, which radiate from a primary, larger and vertical chamber (Fig. 235). The beetle (Fig. 245), is entirely black, or black with brown wing-covers; the head above is flat, concave towards the tip; the thorax

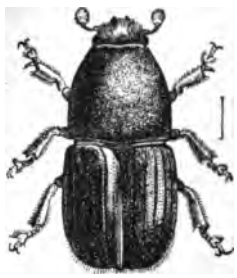


Fig. 245.—*Scolytus 4. spinosus*, Say.

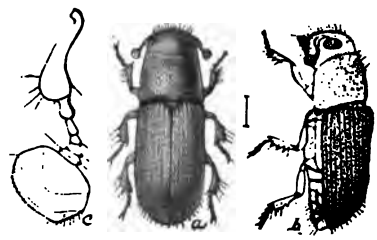


Fig. 246.—*Dendroctonus frontalis*, Zimm.—After Division of Entomology, U. S. Department of Agriculture.

is a little longer than wide, narrower in front; the wing-covers have about ten striæ, confused at the sides, but regular above, composed of small, deep, approximate punctures, the spaces between the striæ having a single row of minute, almost obsolete punctures. The male has the excavated venter armed with two long and two shorter spines, and the rim upon the ventral and posterior segments is also armed with a very stout, short and broad projection; all of which are absent in the female. The entire head is hidden by long and fox-colored hair, more dense in the male than in the female.

Both sexes bore into the tree, the male for food, the female for the purpose of laying eggs. In doing so they bore in a slanting upward direction, both in the trunk and branches. The entrance is usually made in the axil of a bud or leaf, which causes the twig to die, and the leaves to wither and drop. Mr. Bryant, in describing the actions of the female, says, that in depositing the eggs she confines herself to the trunk and larger limbs, placing her eggs on each side of a vertical chamber. Here she dies, and her remains may be found long after her progeny have commenced to make their cylindrical tunnels, at first transverse and diverging, but afterwards lengthwise along the bark, always crowding the widening burrows with their powdery excrement, which is of the same color as the bark. The full grown larva is soft, yellowish, and without traces of legs, with the head slightly darker with brown jaws. It remains torpid during the winter, transforming to a pupa towards the end of the following May. The pupa, also shown, is smooth and unarmed, not showing any sexual differences. The beetles issue through holes made direct from the sap-wood, and a badly infested tree looks as though it had been peppered with No. 8 shot.

A large number of other similar beetles are also destructive to our trees. A small hickory-bark beetle, (*Chramesus icoriae* Lec.), is not alone found in the food expressed by its specific name, but also in the buds of oak, which are greatly enlarged by the irritation produced by its presence.

Pine trees suffer greatly from insects belonging to the genera

Tomicus, *Dendroctonus*, *Hylastes*, and others; and such beetles have to be constantly fought in well regulated pine forests to prevent heavy losses. *Dendroctonus frontalis* is illustrated (Fig. 246), to show the form of such beetles; and a still larger one, very common in our pine forests, the *D. terebrans* Oliv., in Fig. 247.

There is still another beetle belonging to this family that deserves at least passing notice, as it may find its way to our

Fig. 247.—*Dendroctonus terebrans*, Oliv. After Division of Entomology, U. S. Department of Agriculture.

Fig. 248. — *Hylesinus trifolii*, Muell. After Division of Entomology, U. S. Department of Agriculture.

state in the future. It has the rather abnormal habit of making burrows in the roots of clover and allied plants, and it has become a very serious pest in the Eastern States into which it found its way from Europe. A large proportion of the two year old clover plants are destroyed by this insect which can be found in all stages in such snug quarters during the winter months. The clover-root Borer (*Hylesinus trifolii* Muell.), is illustrated in Fig. 248.

FAMILY ANTHRIBIDAE.

(*Fungus beetles*).

There is still another family of beetles closely related to the snout-beetles and bark-beetles. Some of them are found in large numbers upon dead toad-stools; others occur among the fungi causing certain diseases of the cereals and other plants; and still others are known to be elsewhere decidedly injurious to cultivated plants. To show how such beetles look the illustration of *Anthribus cornutus* Say (Fig. 249), has been reproduced from the First Annual Report of the Kansas Experiment Station. This insect was found in large numbers and in all stages associated in dead tamarix stems with the injurious apple-twig borer (*Amphicerus bicaudatus* Say) described before.

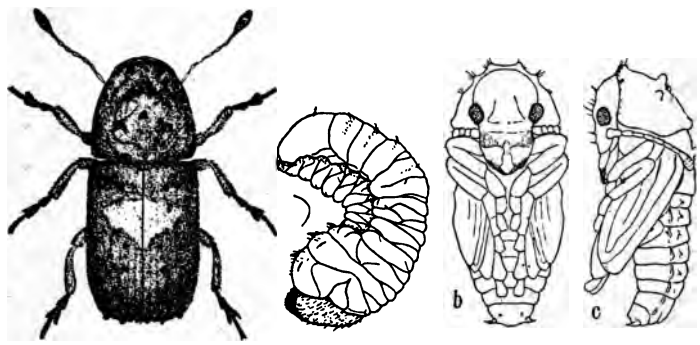


Fig. 249.—*Anthribus cornutus*, Say. After Marlatt.

It will be seen from the pages of this report that the ORDER of COLEOPTERA contains a large number of injurious insects, and that it is worth while to inspect our fruit-producing plants with great care from time to time to detect them, to apply remedies as soon as possible, and not to wait until our enemies have multiplied to such an extent as to make it questionable whether we or the intruders are the masters of the situation.

INDEX.

Page.

Acorn-weevil 216
Adalia bipunctata Linn 35
Adephaga (Typical or True Beetles) 12, 14
Aclimonia femoralis Melsh 152
Adoxus obscurus Linn 141
Agonoderus pallipes Fab 24
Agrilus bilineatus Webb 61
" *ruficollis* Fab 58
" *sinuatus* 61
Agrilus mancus Say 49
Alaus oculatus Linn 46
Allorhina nitida Linn 99
Amara obesa Say 23
Ambrosia Beetles 220
American Currant-borer 121
Ampeloglypter ater Lec 212
" *Sesostris* Lec 212
Amphicerus bicaudatus Say 69, 234
Anametis grisea Horn 183
Anomola binotata Gyll 91
" *lucicola* Fab 90
" *marginata* Fab 91, 92
" *minuta* Burm 91
Anthonomus cratægi Walsh 200
" *decipiens* Lec 200
" *grandis* 200
" *profundis* Lec 200
" *quadrigibbus* Say 196
" *signatus* Say 199
" *suturalis* Say 199
Anthrenus scrophulariæ Linn 40
Anthribidæ 234
Anthribus cornutus Say 234
Apion species 189
Aphodius granarius Linn 78
" *fossor* Linn 78
Aphonus tridentatus Say 96

Page.
Apple Bark-Beetle ... 222
" Curculio ... 196
" Lepturges ... 125
" -smellers ... 26
" -tree Flea-beetle ... 160
" -tree Pruner ... 115
" -twig-borer ... 69
Aramiges Fulleri Horn ... 186
Asparagus-beetle ... 135
Balaninus caryatripes Boh ... 215
" *rectus* Say ... 216
Bark-beetles ... 13, 178, 220
Bark-slippers ... 112
Bassareus spec ... 138
Bean-weevil ... 171
Beautiful Hickory-borer ... 123
Belted " " ... 112
Beetles—Anatomy of ... 1
" Carnivorous ... 12
" " Water ... 13
" Classification of ... 12
" Definition of term ... 1
" Snout ... 5
" True ... 1
Bill-bugs ... 13, 217
Blackberry-borer—Red-necked ... 58
Blaps mortisaga Linn ... 174
Blepharida rhois Forst ... 154
Blister-beetles ... 13, 176
Bockkæfer ... 106
Boletotherus bifurcus Fab ... 175
Bombarding-beetles ... 21
Bostrychus species ... 71
Brachinus species ... 21
Bracon charus Riley ... 55
Brenthidæ ... 216
Brenthus anchorago Linn ... 216
Broad-necked Prionus ... 109
Broad-snouted Beetles ... 13
Brown Parandra ... 107
Bruchidæ ... 170
Bruchus pisi Linn ... 171
" *rufimanus* Sch ... 171
Buprestidæ ... 50
Burying-beetles ... 13, 29
Byturus unicolor Say ... 41

Page.
Cabbage Curculio 211
Cadelles 43
Calandra granaria Linn 219
" *oriza* Linn 219
Calandridæ 217
Calosoma calidum Fab 20
" *frigidum* Kirby 20
" *scrutator* Fab 19
Cantharis Nuttal Say 178
Canthon lævis Drury 76
Carabidæ 17
Carrion-beetles 29
Carnivorous-beetles 12, 14
Carnivorous Water-beetles 13, 24
Carpet-beetles 13, 39
Carphophilus brachypterus Say 42
" *hemipterus* Linn 42
Cassida bicolor Fab 169
" *bivittata* Say 170
Caterpillar-hunter 19, 20
Cerambycidæ 106, 107
Cerambycinæ 108
Cercopeus chrysorhœus Say 184
Chalcodermus species 208
Chalcophora virginiensis Drury 52
Chalepus trachypygus Burm 96
Chauliognathus americanus Forst 205
Checkered-beetles 64
Chelimorpha argus Licht 170
Chestnut-weevil 215
Chilocorus bivulnerus Muls 35
Chion cinctus Drury 112
Chlamys plicata Oliv 138
Chramesus icoriæ Lec 232
Chrysobothris femorata Fab 53
Chrysochus auratus Fab 141
Chrysomela exclamationis Fab 147
" *lunata* Fab 148
Chrysomelidæ 133
Cicindelidæ 14
Cigarette-beetles 67, 68
Clavicornia (Club-horns) 13, 27
Claviger species 30
Cleridæ 64
Click-beetles; Clicking-beetles 13, 45
Clivina impressifrons Lec 21

Page.
Cloaked Chrysomela..... 154
Clover-leaf Beetle..... 190
Clover-root Borer..... 233
Club-horns.....13, 27
Coccinellidæ..... 33
Coccotorus prunicida Walsh..... 196
" *scutellaris* Lec..... 193
Colaspis brunnea Fab..... 142
Coleoptera—Anatomy of..... 1
" Classification of..... 12
" Definition of term..... 1
" Typical or True.....12, 14
Colidium lineola Say..... 228
Colorado Potato-beetle..... 146
Common Lightning-bug..... 63
Copris carolina Linn..... 77
Cop'ocycla clavata Fab..... 169
" *guttata* Oliv..... 169
Conotrachelus cratægi Walsh..... 207
" *elegans* Say..... 207
" *fissunguis* Lec..... 208
" *juglandis* Lec..... 207
" *naso* Lec..... 207
" *nenuphar* Hbst..... 201
" *posticatus* Say..... 207
Corn Bill-bug..... 218
Corn-root Diabrotica..... 151
Corn Silvanus..... 37
Coscinoptera dominicana Fab..... 136
Cotalpa lanigera Linn..... 94
Cranberry Curculio..... 199
Craponius inæqualis Say..... 210
Cremastochilus species..... 104
Crepidodera Helxines Linn..... 163
" *rufipes* Linn..... 163
Crioceris asparagi Linn..... 135
Cryptocephalus species..... 138
Cryptohypnus bicolor Esch..... 48
Cryptus grallator Say..... 55
Cucujidæ..... 37
Cucumber-beetle—Striped..... 150
" Flea-beetle..... 163
Curculionidæ..... 186
Currant-borer—American..... 121
Cyllene decorus Oliv..... 118
" *pictus* Drury..... 118

Page.
Cyllene robiniæ Forst. 118
Darkling-beetles 172
Death-watch 67, 68
Dendroctonus frontalis Zimm. 233
" *terebrans* Oliv. 233
Dermestes lardarius Linn. 40
Dermestidæ 39
Desmocerus palliatus Forst. 120
Diabrotica duodecim-punctata Oliv. 151
" *longicornis* Say 151
" *vittata* Fab. 150
Dichelonycha elongata Fab. 79
" *subvittata* Lec. 79
Dicerca divaricata Say 52
Different Joints (*Heteromera*) 13, 171
Disonycha xanthomelæna Dalm. 157
Divaricated Buprestis 52
Dominican Case-bearer 136
Donacia species 134
Dor-beetles 79
Doryphora 10-lineata Say 146
Drasteria elegans Fab. 49
Dynastes tityrus Linn. 98
Dytiscidæ 24
Echocerus maxillosus Fab. 173
Elaphidion inerme Newm. 117
" *parallelum* Newm. 113
" *villosum* Fab. 115
Elateridæ 45
Elderberry-beetle 120
Elm-leaf Beetle 154
Endomychidæ 37
Engraver-beetles 220
Epicærus imbricatus Say 182
Epicauta pennsylvanica DeG. 177
Epilachna borealis Fab. 36
Epitrix cucumeris Harr. 163
" *fuscula* Crotch 163
" *parvula* Fab. 164
Erotylidæ 37
Euphoria inda Linn. 101
" *melancholica* Gory 103
Eupsalis minuta Drury 216
Eyed Elater 46
Fidia longipes Mels. 138
" *viticida* Walsh 139

Page.
Fiery Hunter 20
Fig-eater 99
Fire-flies 13, 50, 62
Flat-headed Apple-borer 53
" " Borers 50
Flea-beetle of Sumach 154
Flea-beetles 154
Flower-beetles 79, 99
-chafers 13, 79
Fuller's Rose beetle 186
Fungus-beetles 234
Fruit Bark-beetle 229
Galeruca species 152
" *xanthomelæna* Schr 154
Gaurotes cyanipennis Say 120
Genuine Snout-beetles 186
Glow-worm 62
Glyptoscelis crypticus Say 145
Goes debilis Lec 123
" *oculatus* Lec 123
" *pulchra* Hald 123
" *tigrinus* DeG 123
Gold-bug 169
Goldsmith-beetles 79, 94
Gnorimus maculatus Knoch 105
Grain-weevils 217
Grape Curculio 210
Grape-vine Fidia 138
" " Flea-beetle 157
" " " " —Lesser 159
" " Gall-beetle 212
" " Phymatodes 111
" -root Worm 139
Graphops pubescens Mels 142
Gray Anametis 183
Ground-beetles 13, 17
Gyrinidæ 26
Haltica bimarginata Say 157
" *chalybea* Ill 157
" *toliacea* Lec 160
" *ignita* Ill 159
Ham-beetle—Red-legged 66
Hammer-heads 51
Harpalus herbivagus Say 23
" *pennsylvanicus* DeG 23, 205
Herbivorous Lamellicorns 78

Page.
Hermit Flower-beetles 104
Heteromera (Different Joints) 13, 171
Hickory-bark-beetle 231
" -borer—Beautiful 123
" " Common 123
" " Painted 118
" " Two-spotted 117
Hispidæ 166, 167
Histeridæ 41
Hoplia modesta Hald 79
Hydrophilidæ 28
Hylastes species 233
Hylesinus trifolii Muell 233
Hylobius confusus Kby 191
Hylotrupes bajulus Linn 112
Hypothenemus species 229
Imbricated Snout-beetle 182
Indian Cetonia 101
Ips fasciatus Oliv 43
Isomera (Similar Joints) 12, 14
Ithycerus noveboracensis Forst 187
June-bugs 79
Knotty Horn 120
Lace-wings Flies 206
Lachnosterna fusca Froehl 86
" *rugosa* Melsh 88
" *tristis* Fab 88
Lachnosterna species 83
Lady-bugs 13, 33
Læmophlæus fasciatus Nels 38
Lamellicornia (Leaf-horns) 13, 72, 75
Laminiæ 108, 120
Lampyridæ 62
Languria Mozardi Lat 37
Larder-beetles 39
Lasioderma serricorne Fab 68
Leaf-chafers 78
" " —Shining 90
Leaf-horns (*Lamellicornia*) 13, 72, 75
Leaf-feeding Beetles 13, 106, 133
Leaf-rollers 13
" -rolling Snout-beetles 180
Lebia grandis Hentz 23
Lema trilineata Oliv 136
Leptostylus aculifer Say 124
" *macula* Say 124

Page.
Lepturges facetus Say..... 125
Ligyrus relictus Say..... 97
" *rugiceps* Lec..... 97
Light-loving Anomala..... 90
Lightning-bug—Common..... 63
Lina scripta Fab..... 149
" *tremulæ* Fab..... 149
Liopus species..... 124
Little Turk..... 202
Lixus concavus Say..... 191
Long-horned Borers.....13, 106 124
Long-horns..... 107
Lucanidæ..... 72
Lucanus dama Thunb..... 73
" *elaphus* Fab..... 73
Lyctus species..... 71
Macrobasis unicolor Kirby..... 177
Macrodactylus subspinosus Fab..... 80
Madarus undulatus Boh..... 214
Magdalis ænescens Lec..... 192
" *armicollis* Say..... 193
" *olyra* Hbst..... 192
Malachiidæ..... 66
Malachius marginicollis..... 67
May-beetle fungus..... 87
May-beetles.....13, 79, 83
Meal-beetle.....13, 172
Melancholy Cetonia..... 103
Melanotus communis Gyll..... 49
Meloe augusticollis Say..... 178
Meloidæ..... 176
Metallic Wood-borers..... 50
Molorchus bimaculatus Say..... 117
Monarthrum fasciatum Say..... 224
" *mali* Fitch..... 222
Monohammus confusor Kirby..... 122
Mordella 8-punctata Fab..... 175
Mordellidæ..... 175
Museum Pest..... 40
Necrophorus species..... 29
New York Weevil..... 187
Nitidulidæ..... 42
Nodonota puncticollis Say..... 146
" *tristis* Oliv..... 145
Nut-weevils.....13, 214
Oak-pruner..... 113

Page.
Oberea bimaculata Oliv..... 131
" *flavipes* Hald..... 131
Odontota dorsalis Thunb..... 167
" *inæqualis* Web..... 167
" *nervosa* Panz..... 167
" *rubra* Web..... 167
Oil-beet'es..... 13, 178
Oncideres cingulatus Say..... 126
Orsodacna atra Ahr..... 135
Osmoderma eremicola Knoch..... 104
" *scabra* Beauv..... 104
Otiorhynchidæ..... 182
Otiorhynchus ovatus Linn..... 184
" *picipes* Fab..... 185
" *sulcatus* Fab..... 185
Pachybrachys species..... 138
Painted Hickory-borer..... 118
Pale-striped Flea-beetle..... 165
Parandra brunnea Fab..... 107
Parallel Elaphidion..... 115
Paria aterrima Oliv..... 142
" *canella* Fab..... 141
Pasimachus californicus Chd..... 21
Pea-weevil..... 171
Pear-blight Beetle..... 229
Pear-tree Blister-beetle..... 177
Peddlers..... 170
Pelidnota punctata Linn..... 93
Pentilia misella Lec..... 36
Photinus pyralis Linn..... 63
Phymatodes amœnus Say..... 111
Phytonomus punctatus Fab..... 189
Phytophaga (Plant-eaters)..... 13, 106
Phyllotreta vittata Fab..... 166
Pinching-beetles..... 72
Pissodes affinis Rand..... 191
" *strobi* Peck..... 191
Pitchy-legged Otiorhynchus..... 184
Pityophthorus species..... 226
Plant-eaters (*Phytophaga*)..... 13, 100
Platycerus quercus Web..... 74
Plum Curculio..... 201
" Gouger..... 193
" Leaf-beetle..... 145
Pomphopœa ænea Say..... 177
Porizon conotracheli Ril..... 206

Page.
Potato-stalk Borer 211
Predaceous Water-beetles 24
Prioninæ 108, 109
Prionus imbricornis Linn 116
" *laticollis* Drury 109
Pselaphidæ 30
Psenocerus supernotatus Say 121
Psylliodes species 166
Ptinidæ 67
Pyrophorus noctilucus 49
Quince Curculio 207
Raspberry Cane-borer 131
" Fruit-worm 41
" Gouty-gall 58
Red-headed Systena 165
" -legged Ham-beetle 66
" -necked Blackberry-borer 58
" -shouldered Sinoxylon 70
Rhinocerus-beetles 13, 79, 96, 98
Rhubarb-beetle 191
Rhynchites bicolor Fab 180
Rhynchitidæ 179
Rhynchophora 5, 13, 178
Rice-beetles 13
Rose-beetles 13, 32 79
" -bug 80
" -chafer 80
" -leaf-beetle 146
Rosy Hispa 167
Rough Flower-beetle 104
Round-headed Apple-tree Borer 128
" " Borers 106
Sacred Beetle 76
San Jose Scale 35
Sap-beetles 24
Saperda calcarata Say 131
" *candida* Fab 126
" *concolor* Lec 131
" *cretata* Newm 131
" *discoidea* Fab 131
" *lateralis* Fab 131
" *obliqua* Say 131
" *puncticollis* Say 131
" *tridentata* Oliv 131
" *vestida* Say 131
Saw-horns (*Serricornia*) 13, 44

Page.
Saw-horned Borers....13, 50
Sayer.... 122
Scarabæidæ.... 75
Scavenger Lamellicorn Beetles.... 75
" Water-beetles.... 28
Scarred Snout-beetles.... 182
Scolytus quadrispinosus Say....220, 231
" *rugulosus* Ratz.... 229
Scydmænidæ.... 30
Seed-beetles.... 13
Serica tricolor Say.... 83
" *sericea* Ill.... 82
" *vespertina* Gyll.... 83
Serricornia....13, 44
Shining Leaf-chafers.... 90
Shot-hole borers.... 220
Sigalphus curculionis Fitch.... 262
Silken Serica.... 80
Silpha species.... 30
Silphidæ.... 29
Silvanus surinamensis Linn.... 37
Silver-bug.... 122
Similar Joints *Isomera*....12, 14
Sinoxylon basilare Say.... 70
Sitodrepa panicea Linn.... 68
Sitones species.... 187
Small Willow Flea-beetle.... 163
Snapping-beetles....13, 45
Snout-beetles....5, 13, 178
" Genuine.... 186
Soldier-beetles....13, 62
" Two-lined.... 64
Southern June-beetle.... 99
Spanish-flies.... 176
Sphenophorus costipennis Horn.... 217
" *ochreus* Lec.... 217
" *parvulus* Gyll.... 185
Spring-beetles.... 45
Spotted Vine-chafer.... 93
Squash Lady-bug.... 36
Stag-beetles....13, 72, 73
Staphylinidæ.... 32
Strangalia species.... 120
Strawberry Crown-borer.... 209
" Curculio.... 199
" Root-worms.... 141

Page.
Striped Cucumber-beetle 150
Sumach Flea-beetle 154
Systena frontalis Fab 165
" *hudsonias* Fab 165
" *tæniata* Say 165
Tachygonus Lecontei Gyll 209
Tad-poles. 51
Telephorus bilineatus Say 64
Tenebrioides mauritanica Linn 43
Tenebrio molitor Linn. 172
" *obscurus* Fab. 173
Tenebrionidæ 172
Three-lined Lema 136
Thricolepis simulator Horn 185
Tiger-beetles 13, 14
Tile-horned Prionus 110
Tomicus species 223
Tomicus typographus 222
Tortoise-beetles 168
Trichobaris 3-notata Say 211
Trichius species. 105
Trichodes apivorus Germ 65
True Beetles 14
" Snout-beetles 13
Tumble-bugs 75
" -dungs 13
Twelve-spotted Diabrotica 151
Twice-stabbed Lady-bug 35
Twig-girdler 126
Two-lined Soldier-beetle. 64
Two-spotted Anomala 91
" " Hickory-borer 117
" " Lady-bug 35
" " Molorchus 117
Typhia inornata Say 85
Tyloderma æreum Say 209
" *foveolatum* Say 209
" *fragariæ* Ril 209
Tylonotus bimaculatus Hald 117
Typical *Cerambycids* 111
Typical or True-beetles 12, 14
Vedalia cardinalis 35
Vine-chafer—Spotted 93
Virginian Buprestis. 52
Vitis vulnus Ril 212
Walnut Curculio 207

Page.
Water-beetles—Carnivorous....13, 24
" " Predaceous.... 24
" " Scavenger.... 28
Wavy-striped Flea-beetle.... 166
Whirligigs....13, 26
White Pine-weevil.... 191
Willow Flea-beetle—Small.... 163
Wire-worms.... 48
Xyleborus pyri Peck.... 226
" *xylographus* Say.... 227
Zopherus Haldemani Sallé.... 174

"Look Out!"

PLATE I.

Fig. 181.—*Zopherus Hablemani* Sallé. After Sturm.

Fig. 108.—*Euphoria inda* in apple.

Fig. 48.—*Carpophilus brachypterus* Say, in flowers of apple

Figs. 87 and 88.—*A*, *Dichelonycha elongata* Fab.; *B*, *D. subvittata* Lec.; *C*, *Serica iricolor* Say; *D*, *S. vespertina* Gyll.; *E*, *Hoplia modesta* Hald.

PLATE II

Fig. 151.—*Doryphora 10-lineata* Say., and Blister-beetles. Original.

Fig. 192.—*Anametis grisea* Horn.

Fig. 182.—*Boletotherus bifurcus* Fab.; male and female.

PLATE III.

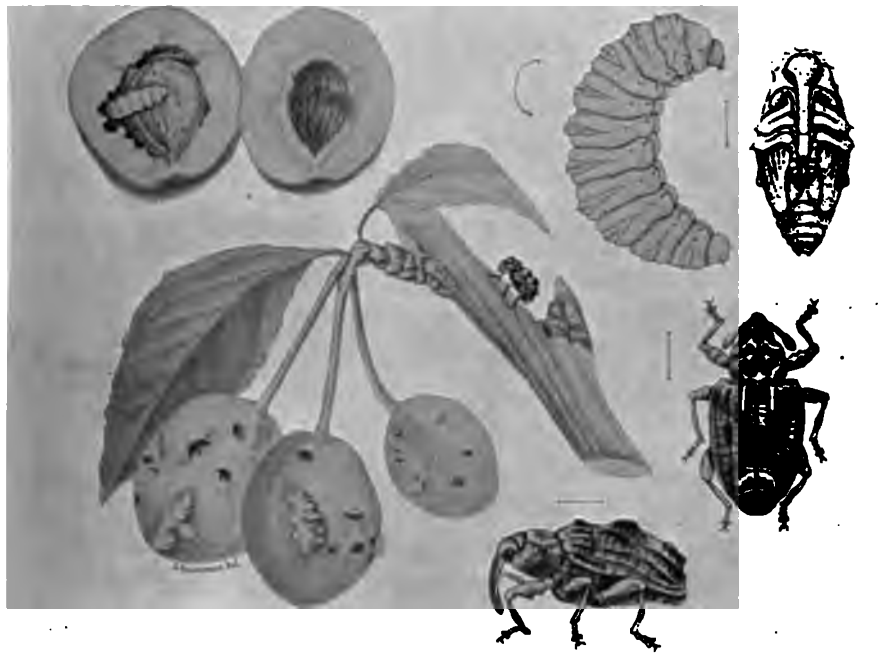


Fig. 213.—*Conotrachelus nenuphar* Hbst. Original.

Fig. 223.—*Tachygonus Lecontei* Gyll. After Sturm.

Fig. 101.—*Cotalp lanigera* Linn. After Harris.

PLATE IV.

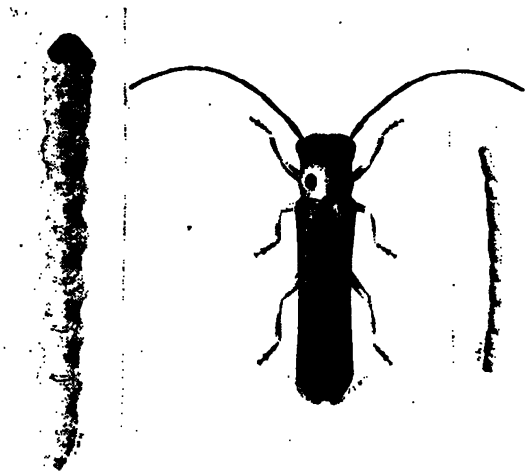


Fig. 136.—*Oberea bimaculata* Oliv.; adult, larva and castings. After Webster.

Fig. 125.—*Gaurotes cyanipennis* Say.

Fig. 114. — *Parandra brunnea* Fab.

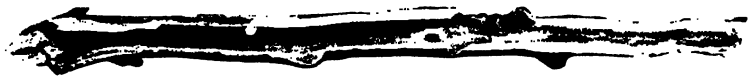


Fig. 136.—Burrow *of Oberea bimaculata* Oliv.

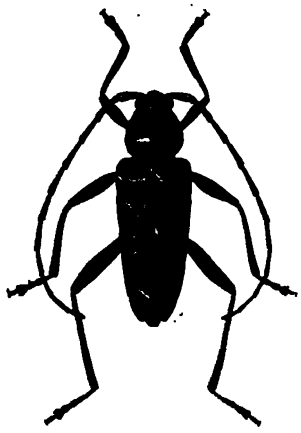


Fig. 122. — *Cyllene pictus* Drury. After Webster.

Fig. 123.— *Cyllene obiniæ* Forst. After Websterr.

PLATE V.

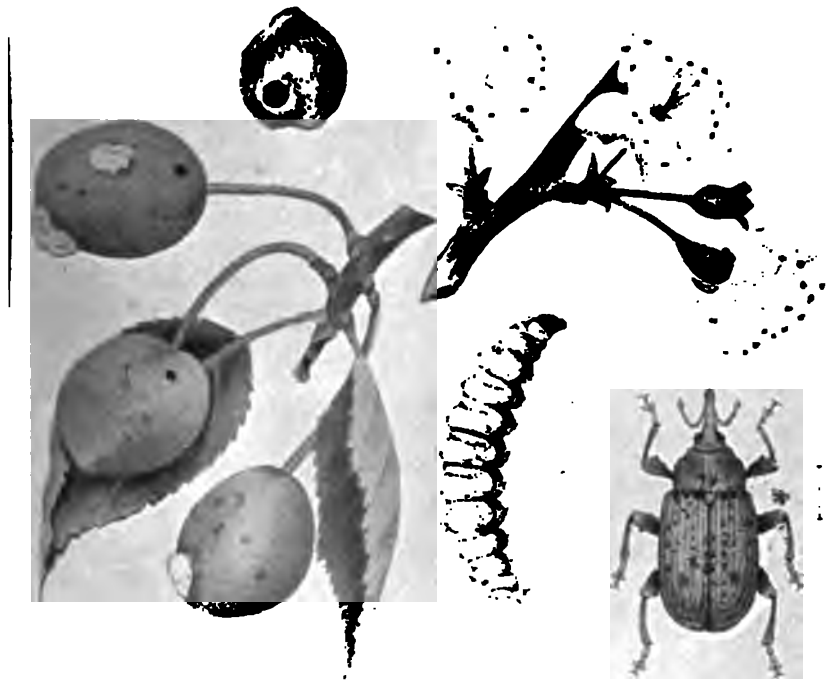


Fig. 207.—*Coccotorus scutellaris* Lec. Original.

. 121. — *Tylonotus bi-aculatus* Hald.

Fig. 81.—*Canthon lævis* Drury; adults, ball and egg.

PLATE VI.

Fig. 124.—*Desmocerus palliatus* Forst.

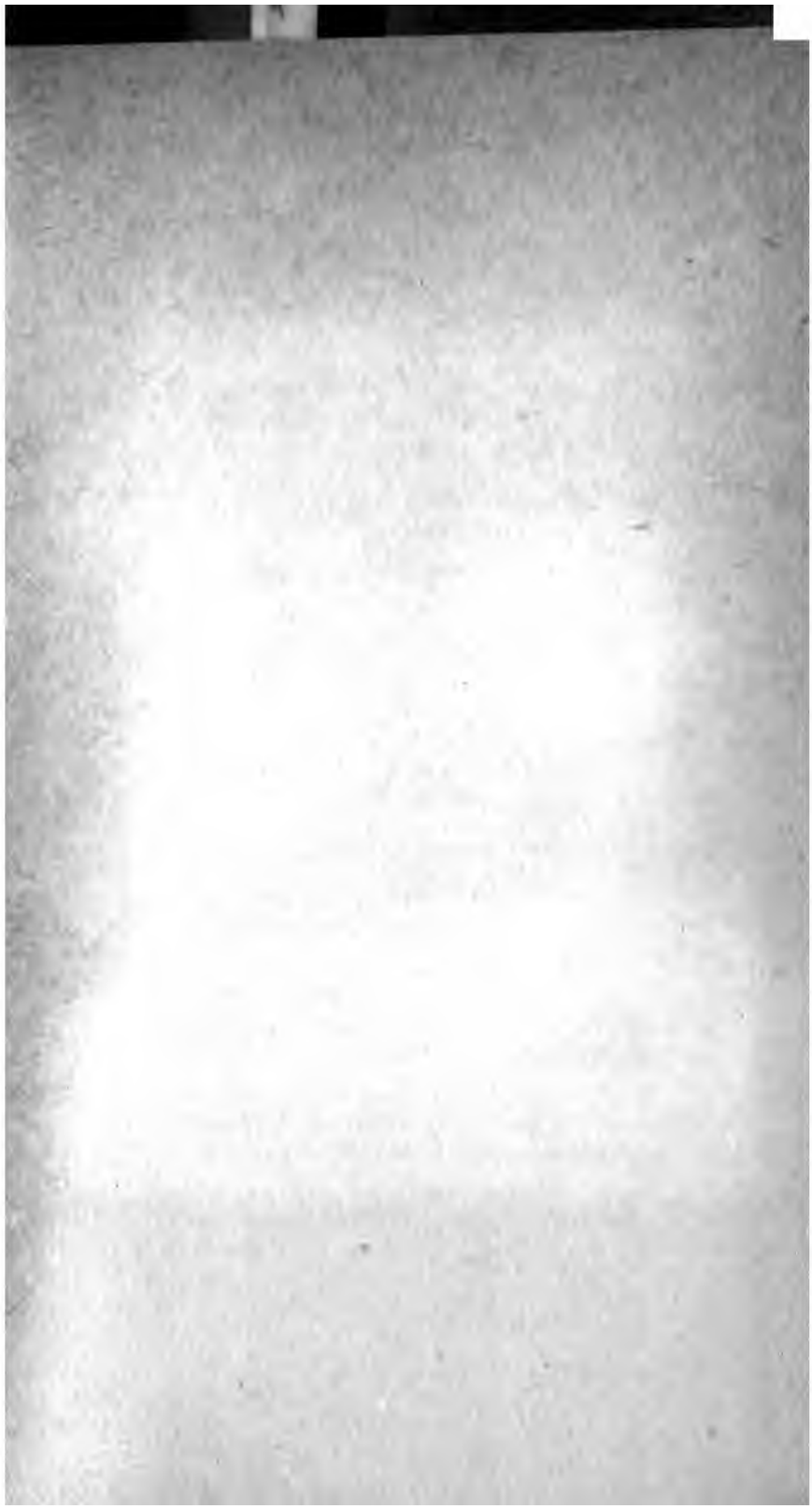
Fig. 129.—*Goes pulchra* Hald.

Fig. 196.—*Ithycerus noveboracensis* ing bark and leaves of plum.

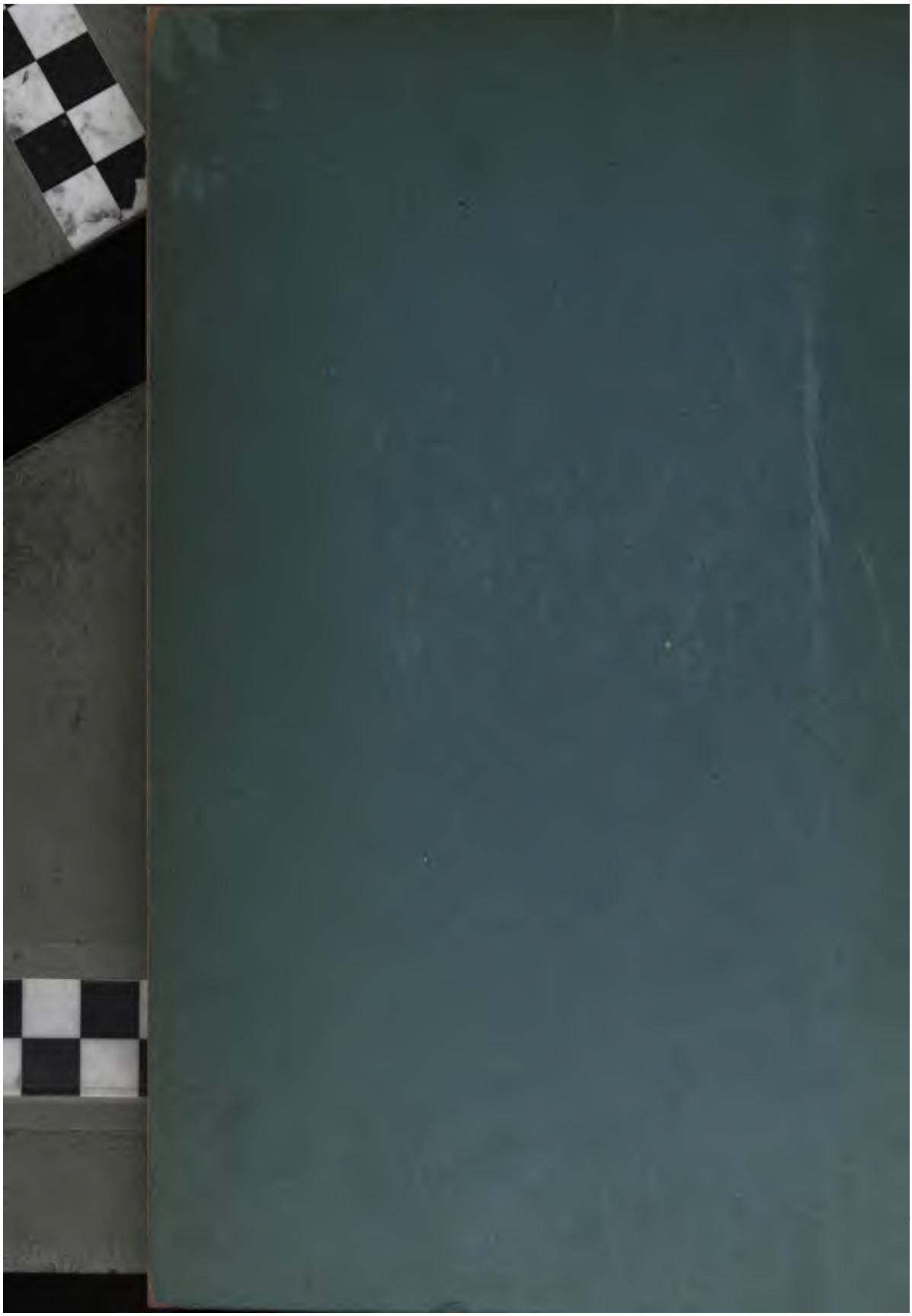
Fig. 113.—*Trichius affinis* Gory.

Fig. 116.—*Prionus* still in burrow.

Fig. 164. *Haltica ignita* Ill.; larv



14 DAY USE
RETURN TO DESK FROM WHICH BORROWED
ENTOMOLOGY LIBRARY
This book is due on the last date stamped below, or
on the date to which renewed.
Renewed books are subject to immediate recall.

LD 21–40m-1,'68
(H7452s10)476

General Library
University of California
Berkeley